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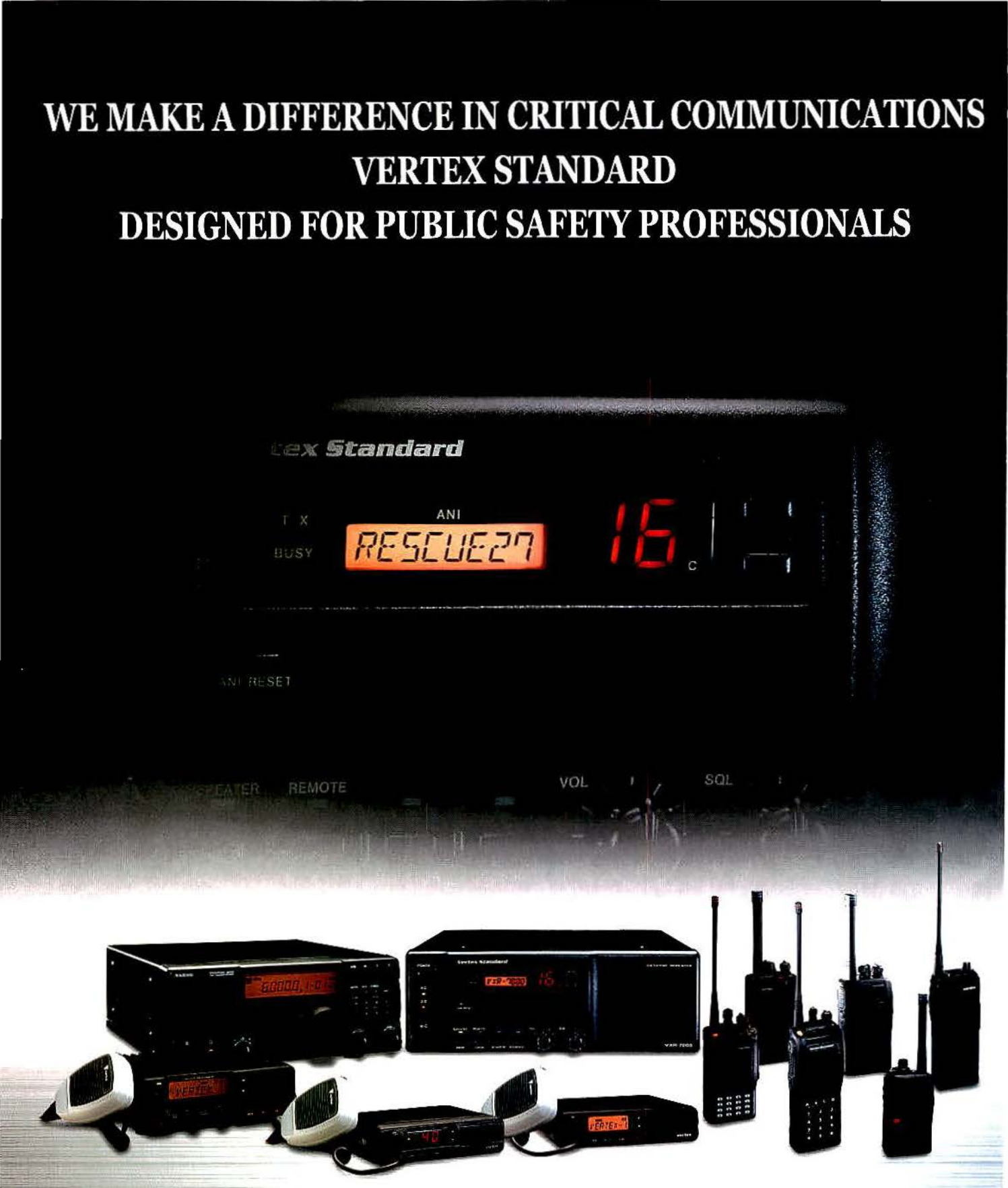

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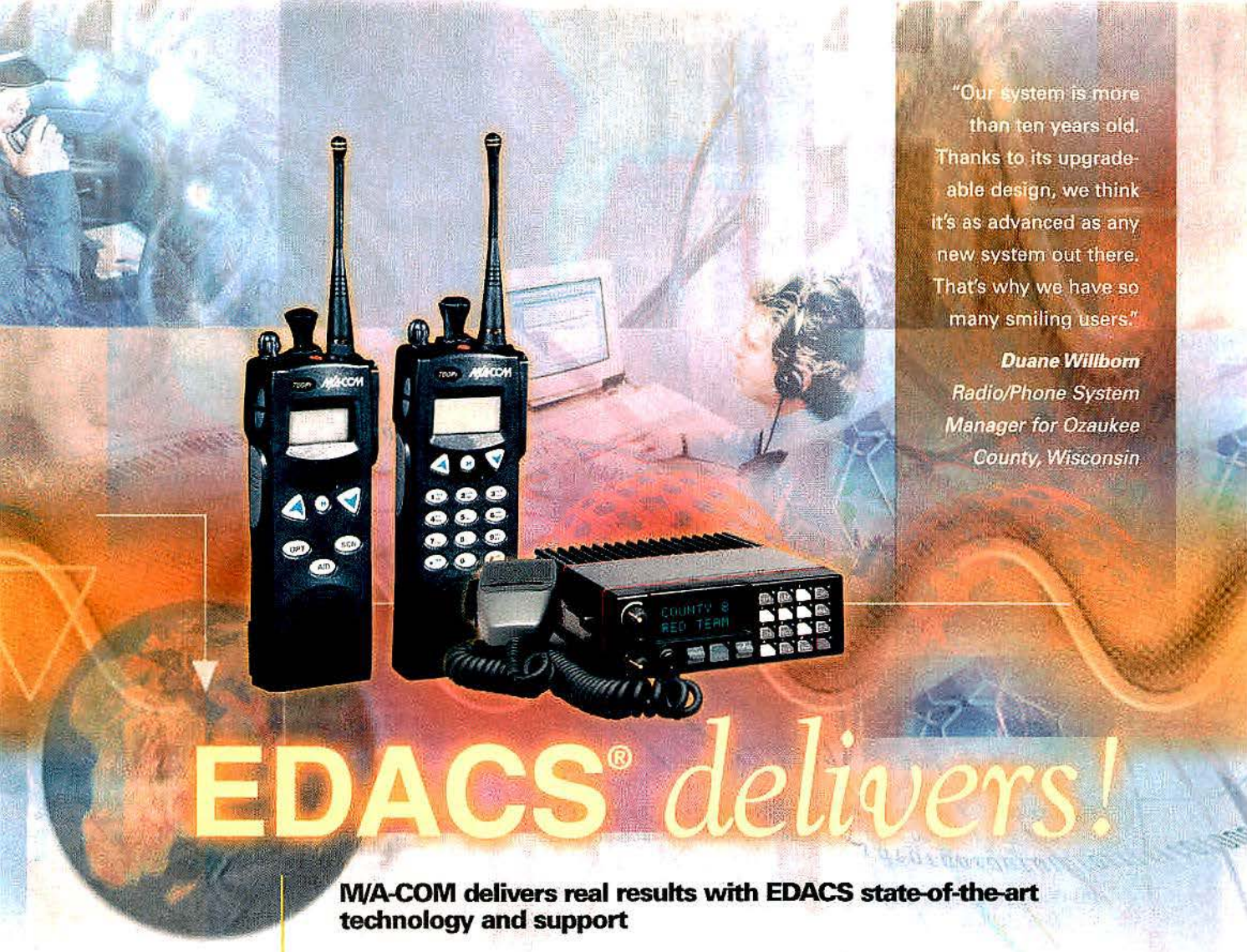

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CIRCLE (4) ON FAST FACT CARD

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CIRCLE (5) ON FAST FACT CARD

Interoperability

When it comes to public safety radio communications, you'll be hard pressed to find a concept that receives more attention than "interoperability."

During radio's Stone Age, when the first few public safety radio systems all used VHF lowband, analog FM and single-channel systems, interoperability meant having a crystal (a frequency-controlling component) and a channel switch that would allow one agency's radios to be used to communicate on another agency's frequency.

As new systems were built to use increasingly higher frequency bands, first VHF highband, followed by UHF and then 800MHz, most agencies on different bands lost interoperability. Some compensated by using scanners to listen to each other's frequencies and communicate cross-band or by installing multiple radio units.

Emulating long-distance telephone switching (remember "trunk lines?"), manufacturers developed "trunking" radios that automatically select from a pool of assigned channels to boost system capacity. A public safety trade group developed a trunking standard, but standard and proprietary systems have proliferated. The difficulty of achieving interoperability increased with multiple frequency bands, multiple trunking protocols and conventional-to-trunked infrastructure incompatibility—offset by mutual aid channels.

Since the introduction of digital radio, representatives of local, state and federal agencies have worked

together to develop a standard protocol (Project 25) for digital radio interoperability within a given frequency band (absent multiband radios) in North America. Alongside those representatives' work, manufacturers developed other digital radio protocols, including another standard, TETRA (sold outside North America). Also included are proprietary protocols, OpenSky and EDACS ProVoice, chosen for use in several statewide, countywide and municipal systems in the United States.

Here in radio's Migraine Age, public safety agencies face a bewildering choice of technologies.

Let's not forget where interoperability begins. It starts with public safety workers (not to mention political leaders, sworn officials, emergency center managers and union chiefs) cooperating, within and among agencies and jurisdictions, to serve the public in the best possible way. It moves forward with organizational tools, such as the Incident Command System, that facilitate coordinated inter-agency emergency responses. It can fail without adequate radio communications.

Some agencies take the lead; others follow. Windows of funding opportunities open, and then close. The age, condition and relative obsolescence of radio systems varies within a geographic area of possible consolidation. Personal and professional rivalries may interfere. Through all this, public safety agencies advance toward interoperability.

Remember when the interoperability of wireless telephone systems was challenged by the development of multiple standards, including one analog and several digital standards on two frequency bands? At no small technical challenge, handsets were developed that operate on two frequency bands with more than one protocol.

As this column was being written, a radio manufacturer announced a similar development for public safety communications: a portable radio that works conventionally, trunked, analog or digital, with SmartNet, SmartZone, Multi-Net and Project 25 protocols, not to mention Project 25 DES-OFB encryption.

Where agencies otherwise do not achieve interoperability, console cross-connects, over-the-air interfaces and multiple-protocol radio units fit as pieces of a puzzle that may never be completely assembled.

Don Bishop

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Various interoperability definitions

1. The use of a standard digital radio protocol, trunked or conventional, so equipment from various manufacturers for a given frequency band would work on a standard system—such as Project 25 in North America and TETRA elsewhere.
2. The use of a common frequency band so that radios using a common trunking protocol, a common digital radio protocol or both (standard or proprietary), or the conventional analog mode could communicate.
3. Operational cooperation among agencies inside and outside a given jurisdiction.
4. The use of interchangeable equipment, including accessories, so workers providing mutual aid can share resources.
5. The common use of the same manufacturer's proprietary trunking protocol, digital radio protocol or both.
6. The ability to spontaneously and immediately talk with a dispatcher or public safety worker from another agency on that agency's frequency, whether using multiple, non-compatible radio units or standardized units.
7. The use of over-the-air cross-band, cross-protocol interfaces, such as the JPS ACU-1000, to allow otherwise non-compatible radio units or systems to communicate when the interface is activated.

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Nextel—'Allowed to break the law'

First of all, Robert Schwaninger did an excellent job summing up the situation ("Dealing with a Rude Neighbor," *MRT*, February 2002). Secondly, after dealing firsthand with Nextel, one thing becomes apparent: It is allowed to break the law. When we have 25kHz spacing on our channels, we use 5kHz or less. Nextel uses the whole 25kHz. If my transmitters were running 25kHz of deviation, my adjacent licensees would scream bloody murder. Nextel uses all 25kHz because it stacks its channels, back to back. If it's the next user, then it's no problem; if you're its neighbor, good luck. I knew I was in trouble when the Nextel field tech used the term "bandwidth" instead of "channel." It seems its technicians have been brainwashed too.

As a government entity who is looking at having to relocate, most likely at our expense, I'm feeling the sensation of having my back against the wall. If it's one thing local governments can do, it's levy taxes. If Nextel won't pay enough, maybe it's time all these affected agencies levy an impact fee against commercial wireless sites inside their boundaries. I know our municipality would make out like a bandit. Perhaps the threat of fines would convince these "bandwidth pirates" that playing within the rules is a less expensive alternative. Maybe other wireless carriers would pressure Nextel in the face of taxation.

The beauty of this is, it's a local solution. The FCC wouldn't have too much to say about a property permit fee, almost like an alarm permit. If Nextel wants to weasel out of paying the impact fee, it has to come ask those who are suffering directly. Someone will have to pay for the Nextel scheme; $500 million won't even put a dent in it. Hopefully, the FCC will come to its senses and make Nextel accountable to FCC regulations again.

—Jason Swift
Radio Shop Supervisor
Coral Gables Police Department
Technical Services Division
EDACS Mastr Technician

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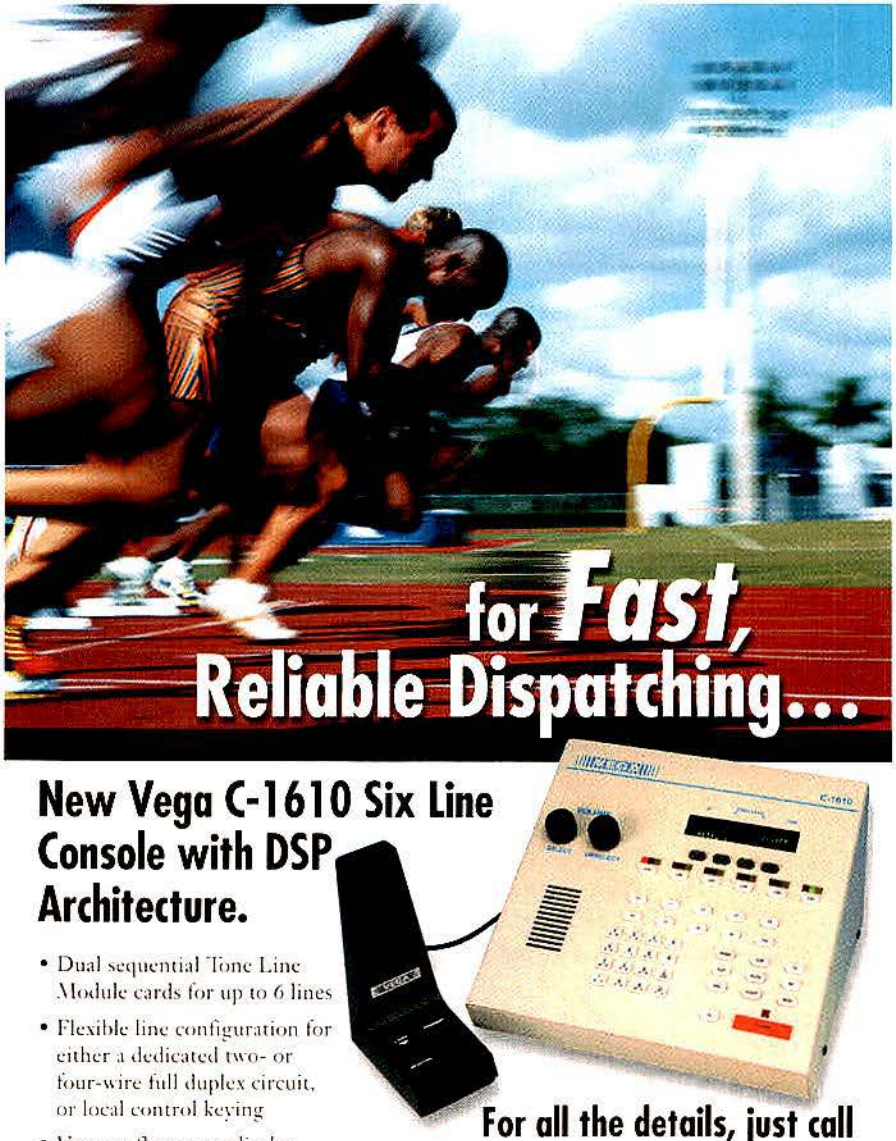

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CIRCLE (8) ON FAST FACT CARD

My first trade show experience

Even though the International Wireless Communications Expo isn't until April, the editors of *MRT* start getting ready for the show in January. I had no idea so much effort goes into pre-show and show issues. And that's not counting the IWCE Live! Web site coverage the editors provide during the show.

I attended IWCE last year, but I had only been with the *MRT* staff two weeks. I remember sitting on the plane on the way to Las Vegas thinking, "I'm going to a trade show in Las Vegas after only two weeks on the staff. I love this job!" My first trade show proved to be more than I ever expected.

First of all, the showroom floor is enormous. I now know that it is not humanly possible to visit each booth by yourself by the end of the show. I know because I tried.

Besides realizing you need to wear comfortable shoes to IWCE, I also learned that IWCE is the major trade show for the mobile radio industry. Exhibitors and attendees come because they want to meet and greet, to introduce new products and services and to learn more about events in the industry. IWCE is the best place to do these things.

Because a lot of people attend IWCE, many companies choose to make major announcements during the show. Last year the talk on the show floor was about the possible sale of all or part of Com-Net Ericsson's business to Pembroke, Bermuda–based Tyco International, a diversified manufacturing and service company with annual sales of $28.9 billion. Also, ElectroCom Systems announced at the show that it had changed its name to IPMobileNet.

I also had no idea you could win prizes or get free food at a trade show. Last year one lucky person won a brand new, red Volkswagon Beetle. That's not just a prize, that's like winning the lottery. OK, not exactly—but close. For everyone else at the show who wasn't lucky enough to win the car, we found food and other giveaways. The *MRT* booth gave away ice cream sandwiches and drumsticks (and magazines). I'm thinking this year we should upgrade to sundaes with chocolate syrup and whipped cream. Well, maybe that's not as easy to carry around the show floor.

Another memorable event at IWCE was a live tiger at the Anchor Graphics Marketing booth. With the launch of its new marketing campaign, a "rare breed" in the label industry, the company decided to bring along the rare-breed tiger. I wonder what they'll bring this year?

I know many of the readers have been going to IWCE since its inception, but if you can think back to your first trade show, you can probably understand my awe. My first experience with IWCE was definitely an interesting one. On the plane ride home I remember thinking, "Wow, what a busy week. How am I going to remember everything I learned and the names of everyone I met? I need a vacation!"

Kari Taylor
Associate Editor
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CIRCLE (10) ON FAST FACT CARD

Boxes and lines

By Robert H. Schwaninger Jr.

On Jan. 17, the FCC announced that it had approved (following union consent) a reorganization of the agency. Like baseball realignment, the union reps and the owners got together and decided that the FCC would reorganize for the purpose of increasing efficiencies and providing a more balanced schedule for future games.

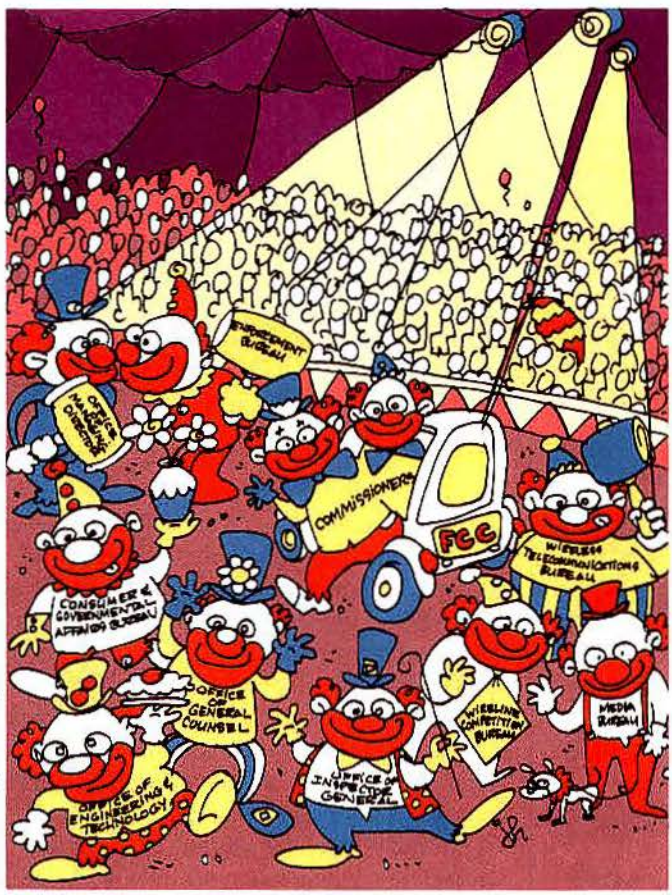

Illustration by John Hayes

Along with the notice was the typical chart, showing boxes in which each department of the agency was identified by title and duties. The reorganization is interesting and highlights the direction in which the FCC is headed. To assist my readers in understanding how the agency works, here are descriptions of the subparts of the FCC.

The commissioners – This is the body of politicians that runs the show and gets all of the photo ops. The four members (one position is vacant) spend time attending trade functions and international symposia, while their staffs keep up the day-to-day functioning of the agency. About once a month, they meet and vote on whether SBC and Verizon should merge and put the whole shebang out of business via outsourcing.

Office of Engineering and Technology – This office is responsible for all of that geeky engineering stuff, including the review of equipment to see if it should be operated in the market. To prove that the work they do is scientific, their main facility is referred to as the FCC "laboratories." It is believed that this is the only group within the agency that uses a spectrum analyzer for anything other than an electronic lava lamp at office parties.

Office of Inspector General – This is the office that makes sure none of the FCC employees are walking off with office supplies. It produces yearly reports to Congress and the chairman to explain that a careful counting of rubber bands and paper clips demonstrates that shrinkage is within tolerable norms.

Office of General Counsel – This office is filled with lawyers, which should worry anyone. Its job is to review what the agency has done for political reasons and to give the results the patina of legality. When you challenge the FCC's decisions, this is the group that sends the lawyer to court to repeat the mantra, "The agency has broad discretion ... the agency has broad discretion ..."

Office of Managing Director – This is the office that cashes the checks for filing fees. It is also in charge of internal housekeeping. Think of this as the office manager and billing department. If you want a refund, these are the guys who decide the issue.

Beneath the "offices" are the bureaus. This is where the bulk of the reorganization is taking place. For example:

Wireline Competition Bureau – Its title suggests that the agency is really serious about jump-starting local wireline competition. If you don't believe it, just look at the title. Also, check out the millions of dollars in fines the FCC is levying against some of the LECs who promised that they would create a competitive environment and have shockingly failed to help spur competition in their marketplaces.

Enforcement Bureau – Instead of having each bureau engage in investigation and enforcement of rules violations, the FCC has consolidated this function into one bureau that is supposed to kick in the doors, search the papers and haul the bad guys into court. The concept is good. However, I have noted that some of the bureau's employees lack the specific knowledge of operations that the other bureaus have about their group of regulatees. But, give it time, and this bureau may become one of the

Schwaninger, *MRT's* regulatory consultant, is the principal in the law firm of Schwaninger & Associates, Washington, which is counsel to Small Business in Telecommunications. Schwaninger is also a fellow of the Radio Club of America. His email address is *rschwaninger@sa-lawyers.net.*

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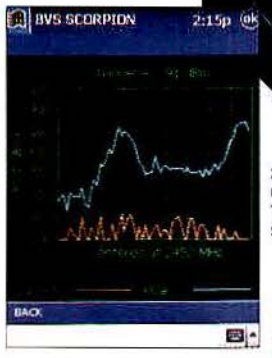

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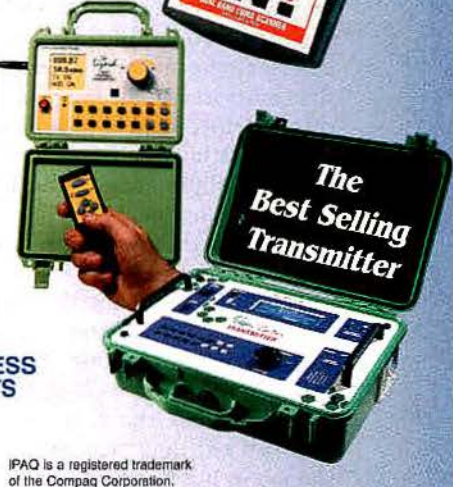

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CIRCLE (11) ON FAST FACT CARD

most visible.

Wireless Telecommunications Bureau – If a device sends a radio signal from a licensed station and the signal isn't television or broadcast radio, the WTB is the bureau that regulates it. Public safety, private, commercial, cellular, PCS and microwave all fall under this bureau. The auction division does too. These are the people who made popular the phrase "exponential smoothing."

Media Bureau – The FCC combined cable and broadcast regulation under this single bureau. What is not clear is whether the new Media Bureau will also regulate ISP offerings over broadcast facilities. Likely it will, but one has to wonder how this hybrid of wireline and broadcast will be handled.

Consumer and Governmental Affairs Bureau – This bureau grew out of the old Field Operations Bureau's hotline call-takers who sought to respond to consumer and licensee questions about whether the FCC cared that your phone bill was harder to read than the tax code. Don't call them about violations of FCC rules. Call them if you want to know who to call. They are better with referrals than answers to specific questions.

The agency also sports the Office of Media Relations (office of flack); Office of Plans & Policy (the futurists, economists and people who never have to pay for implementation of their ideas); Office of Communications Business Opportunities (the never-heeded office that supports small business concerns); Office of Workplace Diversity (beats me); and Office of Legislative Affairs (where the FCC's lobbyists hang out).

The only thing in the reorganization that remains a mystery is why the Enforcement Bureau got stuck with regulating common-carrier audit functions. The only thing I can figure is that the bureau chief left the room to heed nature's call and was voted into the job in his absence. ■

A PRIMEDIA Publication

MRT MOBILE RADIO TECHNOLOGY®

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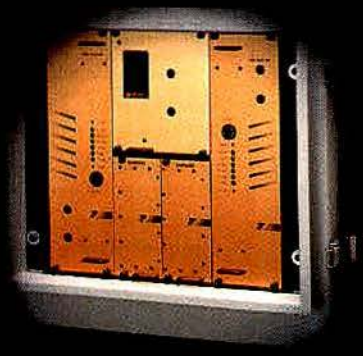

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CIRCLE (12) ON FAST FACT CARD

'It's not a question of money ...

It's just a question of the amount.'

By David O. Dunford

I met Ben Sayevich almost five years ago. Ben is a Lithuanian who emigrated to Israel at an early age and served in the Israeli Defense Force. In true government fashion, because Ben was an accomplished concert violinist, the Israeli Army made him a supply sergeant.

He has taught at the University of Kansas for several years and has recently become an American citizen. He's a good friend and a smart guy full of witty and accurate sayings, the one above being a favorite. Ben doesn't know much about two-way radio or police communications—but he is "right on" about the new economy of wireless technology.

A better future

To be fair, I really do want (and expect) things to be better and cheaper in the future, especially communications systems and equipment for public safety users. So how do private radio system costs compare to commercial system costs? For the sake of discussion, I've made some basic cost assumptions:

1. Typical ARPU for a commercial wireless phone is about $70 per month.
2. A full-time user works 160 hours per month (40 hours per week × 4 weeks).
3. There are 720 shift-hours per month (24 hours per day × 30 days per month).
4. Hence, for each user billet on the

Dunford, *MRT's* public safety consultant, is technical services consultant for the Lenexa, KS, Police Department. He is a member of the Association of Public-Safety Communications Officials–International. You can email Dunford at *mrt@primediabusiness.com.*

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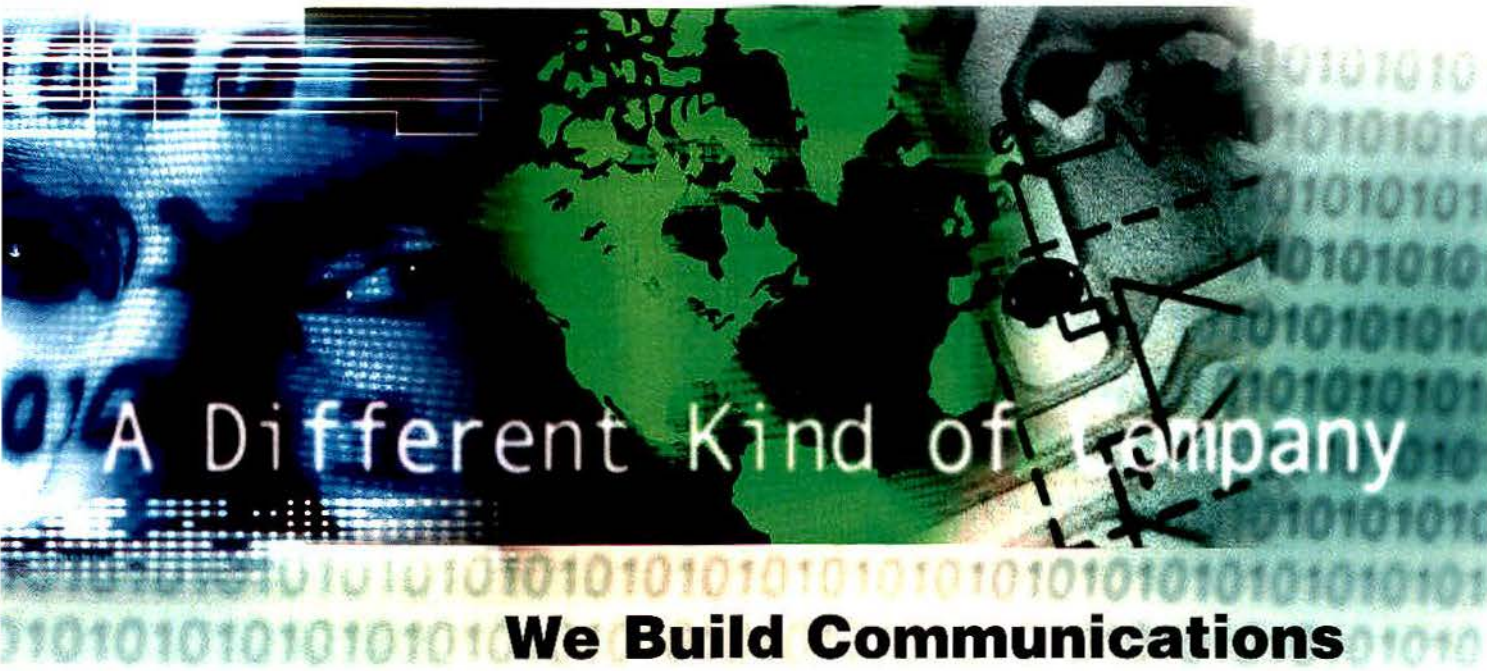

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CIRCLE (14) ON FAST FACT CARD

schedule, there should be 4.5 monthly "costs" budgeted. This works out to about $315 per user per month in equivalent monthly costs or about $3,780 per year per radio user for the commercial service option.

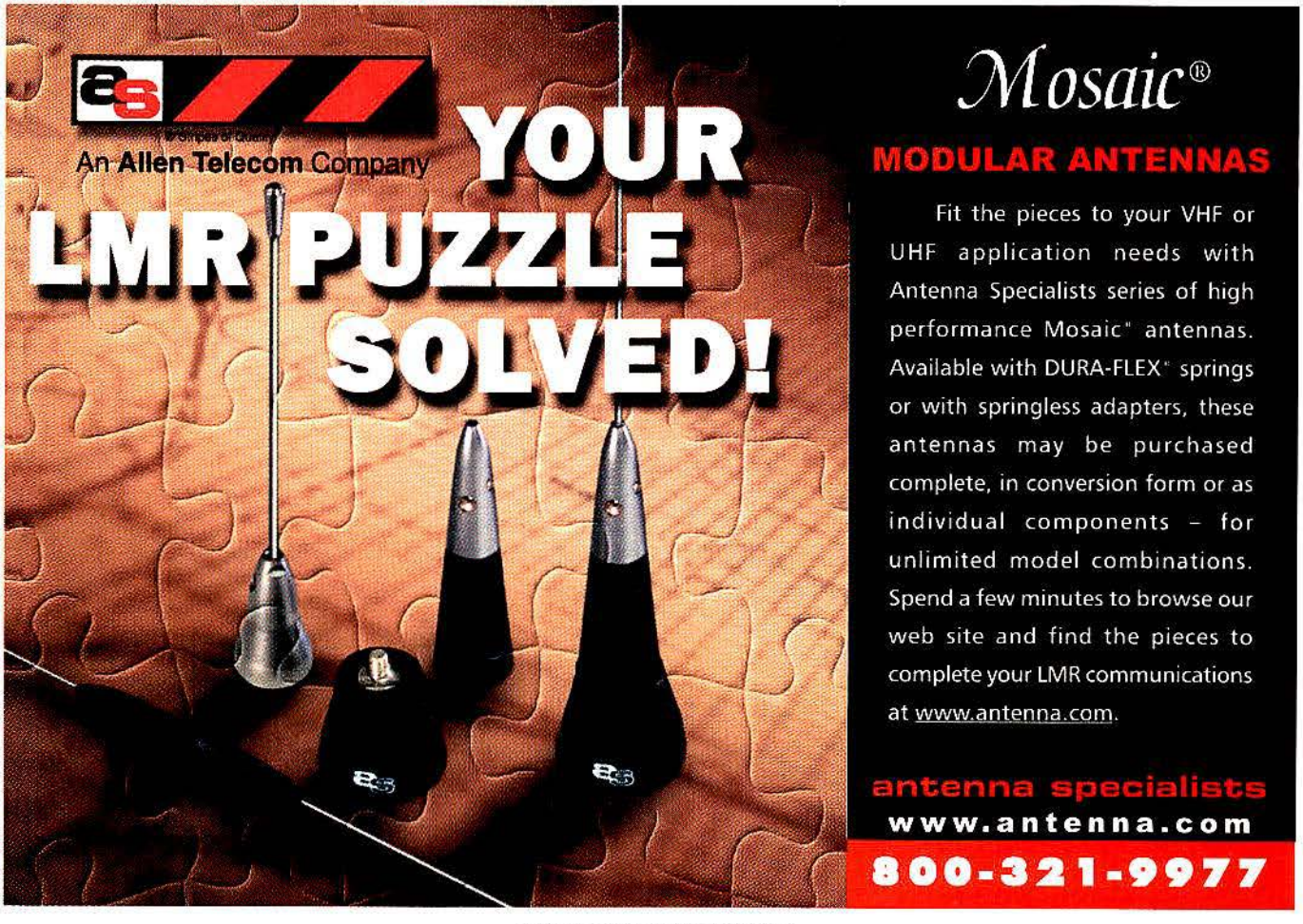
Dave's prediction of the obvious: 'Big-picture' entrepreneurs will (some already have) devise a way to leverage the benefits of private radio systems into a monthly service ...

For a police department with 25 sworn officers, this works out to about $95k per year just for backbone or network services not including user equipment costs. But the cost of commercial handsets is subsidized and each unit is sold for, let's assume, only $100 for a product like the Nextel i1000. Typically, public safety users will need to replace these units at least four times per year for an annual fleet cost of another $10k. That brings the commercial system option up to $105k per year or $525k for a five-year life-cycle system cost. Ouch!

Predictions

Land mobile radios aren't subsidized (quite the contrary from the Major Firm) and each unit is sold for, let's say, $650. Let's assume an effective life of five years for mobile and portable radios and that each department user has both products. Further, it seems fair that our private radio system won't need nationwide coverage, so network design (and costs) can be reduced. Being wildly pessimistic, let's assume that the backbone network components, including sites, radios, towers, communications links and maintenance for this small department, will cost $25k per year. At the end of the same five-year life cycle, the private radio system has cost only $157k—and we still own the gear.

Dave's prediction of the obvious: "Big-picture" entrepreneurs will (some already have) devise a way to leverage the benefits of private radio systems into a monthly service with reasonable ARPU for public safety consumption without the periodic capital costs of system acquisition and construction. After all, when it comes to money, it's just the amount we look at. ■



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CIRCLE (16) ON FAST FACT CARD

The dead

By James Careless

Stowe, VT, and surrounding Lamoille County include what is undeniably one of the world's favorite ski areas. But police, fire and emergency medical services have to cope with large radio coverage "dead zones" that can delay service to the public and deny backup for police officers and other public safety workers.

Lamoille County's public safety radio communications networks are plagued by terrible coverage. It's so bad that their 5W Motorola analog portables (UHF for police; VHF for fire and EMS) "only cover about 32% of our territory," said Lamoille County Sheriff Roger Marcoux. "Meanwhile, our 100W mobiles do better at 54%, but that's still not good enough."

George Spoerl, the county's senior dispatcher, said that as a result, "we have a very tough time. A lot of areas are very dead."

Poor radio coverage puts the public at risk. "For instance, if you're in a car accident, our portables often can't reach back to dispatch to alert the hospital," said Marcoux. "This means our people have to run back to their mobiles to get through. As you can imagine, this can be difficult at times."

However, the danger also extends to local public safety workers—especially police, who patrol singly. "There could be a raging gun battle taking place, and yet you couldn't get hold of anyone," said Stowe Police Chief Ken Kaplan. "To put it mildly, this puts our officers' lives in danger."

A case in point: A few months ago, an off-duty police officer spotted and gave chase to two suspects in a stolen car. Both were wanted for numerous burglaries and car thefts, and both had eluded capture before.

Not surprisingly, the officer called for backup units to help corral the suspects. However, due to the Lamoille County radio system's dead spots, it was virtually impossible to coordinate the operation.

"It was frustrating, to say the least," said Marcoux. "The dispatcher was unable to ensure the officer's safety, because he kept losing him. As well, the responding units couldn't talk to each other, let alone the officer who was actually behind the suspects.

Careless is a freelance telecommunications writer based in Ottawa, ON, Canada. His email address is *james@tjtdesign.com*.

zone

The Stowe, VT, ski region is ripe for public safety radio improvements. Geography, budgets and NIMBY stand in the way of proper coverage.

"The result was that a chase ensued that ran 25 or 30 miles, and the suspects eventually got away. Had we had better communications, they would have been apprehended."

Tower shortage

The mountains and valleys that make Vermont so picturesque—and Lamoille such a great skiing location—make radio communications a nightmare. Lamoille County sets an example of especially difficult coverage, where a few towers must serve 461 square miles of rough terrain.

An 80-foot tower serves the town of Stowe's UHF communications for police and VHF communications for fire and EMS. A UHF link connects the Stowe tower with the Lamoille County Sheriff's Department's 120-foot tower at Hyde Park. That county tower provides communications for police, fire and EMS. The Sheriff's Department also has a 100-foot tower at Carpenter Hill that includes a UHF repeater for the Stowe Police Department and a rooftop antenna at the Cambridge Fire Department near the Smuggler's Notch ski resort.

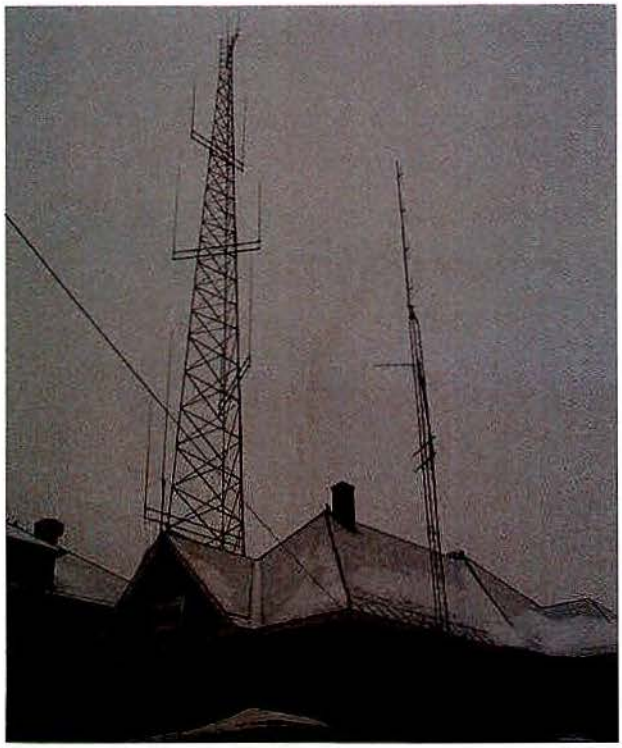
This complement of sites is insufficient to provide 95% coverage, the generally accepted standard for public safety network performance. To reach this goal, the region should have "several tower sites to supply the required public safety coverage levels typically required by government agencies," reads the $35,000 "Lamoille County, VT, Public Safety Communications Study" prepared last year by RCC Consultants.

All told, Lamoille County encompasses 10 towns and 23,233 people, according to the 2000 U.S. Census. However, during winter weekends and holidays, the population swells considerably as people flock to Stowe and Smuggler's Notch—named for the caves that held smuggled goods during the War of 1812 and booze during Prohibition.

"For instance, in Stowe our normal population is 4,200, but on weekends it swells to anywhere from 20,000 to 25,000," Kaplan said.

Not surprisingly, most of these tourists are on the slopes, where ski patrols are always active. Unfortunately, when things go wrong, it's not always easy to get the word out.

"We have a fair number of backcountry and high-angle rescues," said Neil Van Dyke, Stowe's director of emergency services.



The Lamoille County Sheriff's Department tower stands 120 feet at Hyde Park, providing communications for police, fire and EMS.

"However, in much of the region, we're not able to speak directly to the dispatcher from the field. We tend to set up a mobile relay truck to help out, but even with that, coverage can be spotty at times."

Marcoux added: "We have a real problem in the ski area. We desperately need to have a tower there."

To make matters worse, many tourists enjoy Lamoille County so much that they buy land in suitably picturesque and isolated locations. In many cases, the homes they're building are in dead zones. In fact, the county's population rose 17.7% percent from 1990 to 2000, according to the U.S. Census Bureau. In contrast, Vermont's population growth for the same period was 8.2%.

So why not build new towers and fix the coverage problem? Despite its tourist areas, Lamoille County isn't exactly rich. According to the Census Bureau, the county's median household income is $33,418.

Beyond money, there's also the question of NIMBY, or "not in my back yard." Vermont is noted for its landscape, which is why many of its residents don't take kindly to new towers. This explains why an effort to raise a 160-foot tower on Carpenter Hill has spent five years in legal wrangles. The radio equipment for this tower, which has already been purchased, has languished in storage for several years.

Ironically, the RCC study has given the Garfield Hyde Park Neighborhood Alliance, which opposes the tower, the ammunition they need to defeat it. Because the study says the proposed tower would only improve coverage by

Consultant viewpoint

Lamoille County contracted RCC Consultants, Woodbridge, NJ, to help with its radio coverage problems.

An RCC engineer, Norm Boucher, said that several repeater sites would be required to provide reliable service to hand-held radios and for alert paging because of the county's mountainous terrain.

FCC rules about repeater power complicate the matter. Power reduction tables (the "Safe Harbor" tables) would require proposed high-elevation sites in Lamoille County to use transmitters limited to 5W to 10W ERP. Boucher said that using lower-elevation sites with higher power would require increasing the number of sites—and that would further increase the cost to the county.

"The balance point is very difficult to find," Boucher said.

The county also needs more radio frequencies for full coverage. Boucher said it would be difficult to find sufficient VHF frequencies to fully implement their plan. He explained the Canadian government's assent would be required because of the county's proximity to Canada, and that the Canadian government typically rejects proposed U.S. frequency assignments along the border.

For fire department communications, Boucher explained that many of the county's small fire departments have radio systems that use repeaters with pole-mounted antennas in the fire yards that give limited coverage. The resulting lack of countywide coverage for firefighting makes tactical radio communications during mutual aid responses difficult.

Boucher said that the county routinely uses a mutual aid channel to dispatch fire departments for three or four communities. The RCC study found that the channel has 60 co-channel users. Boucher said that at any given time, usually someone is talking on the channel, making it a poor choice for dispatching.

Although RCC indicated that some VHF channels might otherwise be available to the county and suitable to use in improving its radio operations, Boucher said that more research would be needed to verify that the channels are usable. And even then, the routine rejection of U.S. coordination requests for VHF operations by the Canadian government would have to be overcome.

—Don Bishop

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It is not always easy to get the word out when things go wrong on the ski slopes.

1%, "it's not like this thing is going to save lives," Garfield resident Eric Beckstrom was quoted as saying in the *Stowe Reporter*.

Attempts at solutions

Despite this unintentional unhelpful observation, the RCC survey offers two options. The first is to do nothing, which the RCC study says "is not the recommended approach." The second, which RCC and the county's public safety agencies do endorse, is to take a three-phase approach to the problem.

In Phase I, which would cost anywhere from $946,000 to $1.2 million, the county would build a new 100-foot tower and transmission facility at the existing Carpenter Hill site. In addition, a new transmission site would be constructed on Madonna Peak at the Smuggler's Notch Resort. Mounted

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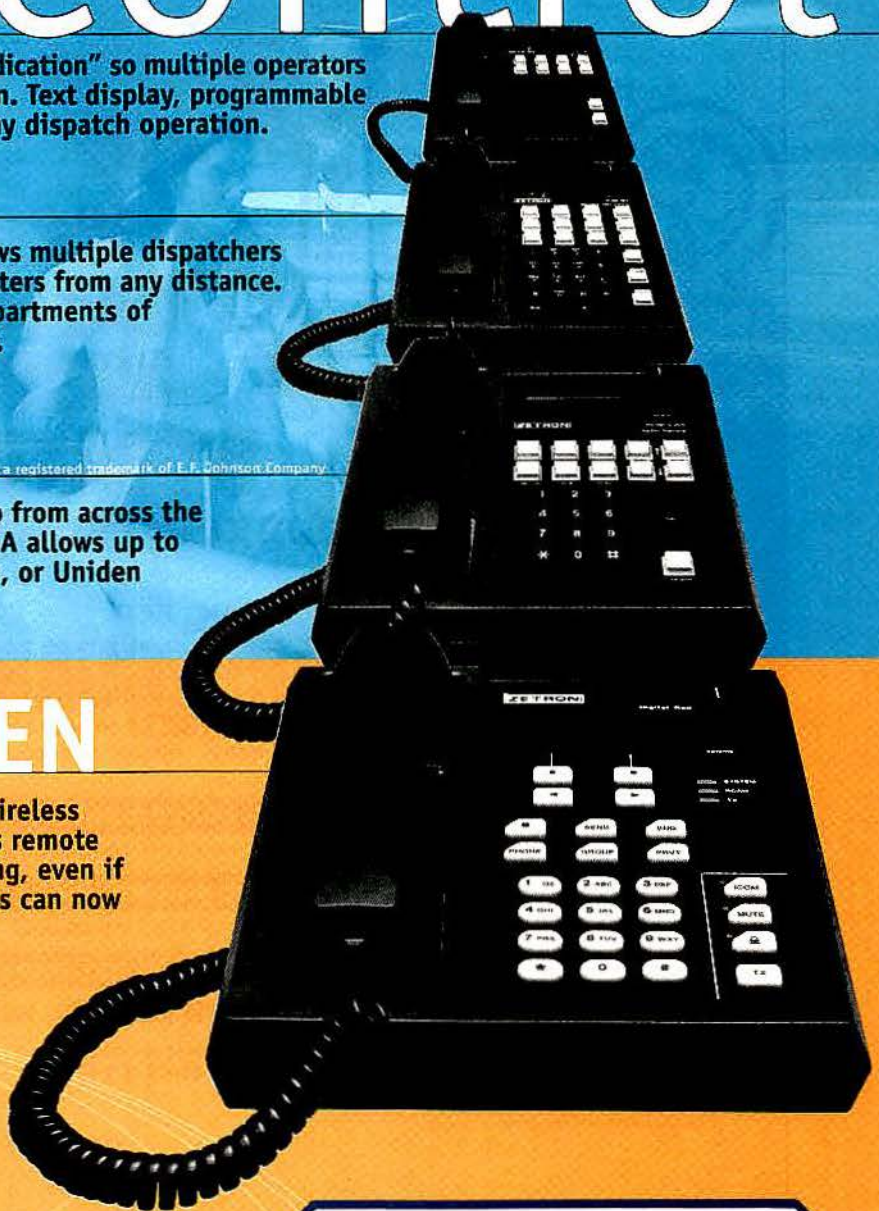

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on the peak's chair lift machine at 3,647 feet, the antenna would vastly improve coverage in this part of the county. What's more, the whole permit hassle could be avoided because this phase relies on existing structures. Throw in some microwave links and county-wide channel reorganizations, plus other related equipment, and radio coverage would improve in Lamoille County.

But it wouldn't improve enough. That's why Phase II calls for three more transmission sites, including three 180-foot towers at a cost between $1.7 million and $2.4 million. Phase III would expand microwave links and improve portable radio performance for an additional $1 million to $1.3 million.

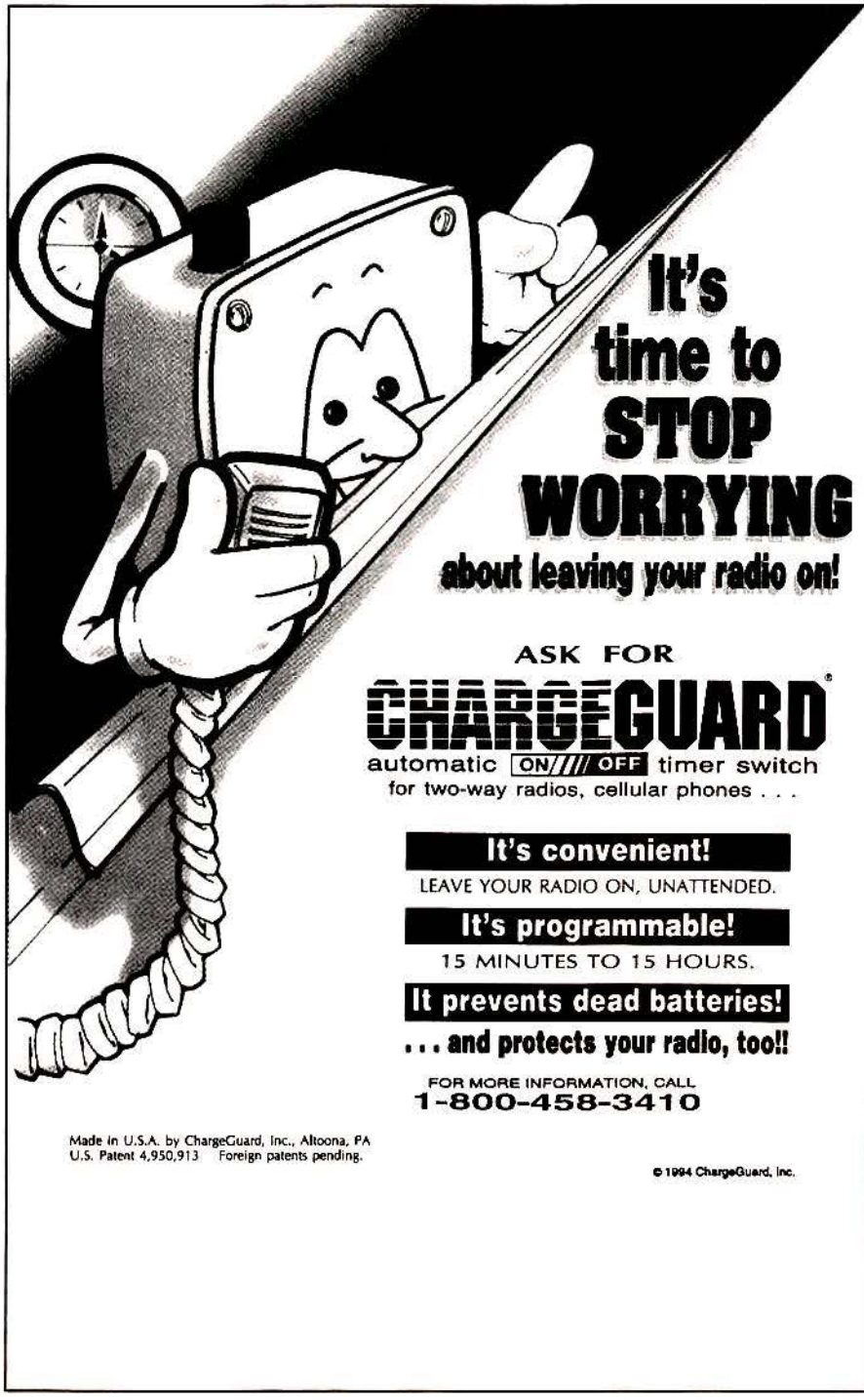
The Carpenter Hill tower.

So what's happening? Not much. The problem is money, said Marcoux. "Right now, if we could get $900,000, we could do Phase I and attach a microwave dish and antenna at Madonna Mountain."

Given the current state of the economy, it's unlikely that either the county or state governments will allocate the necessary funds for Phase I, let alone Phases II and III. That's why Marcoux and his colleagues are hoping to get some funds from the federal government's Homeland Security budget.

"We don't know what the criteria or the process will be," said Neil Van Dyke. "But we've had a pretty strong indication that something's coming."

The county's public safety agencies hope so. After all, how can an agency do its job when two-thirds of its territory is in a radio dead zone? ■



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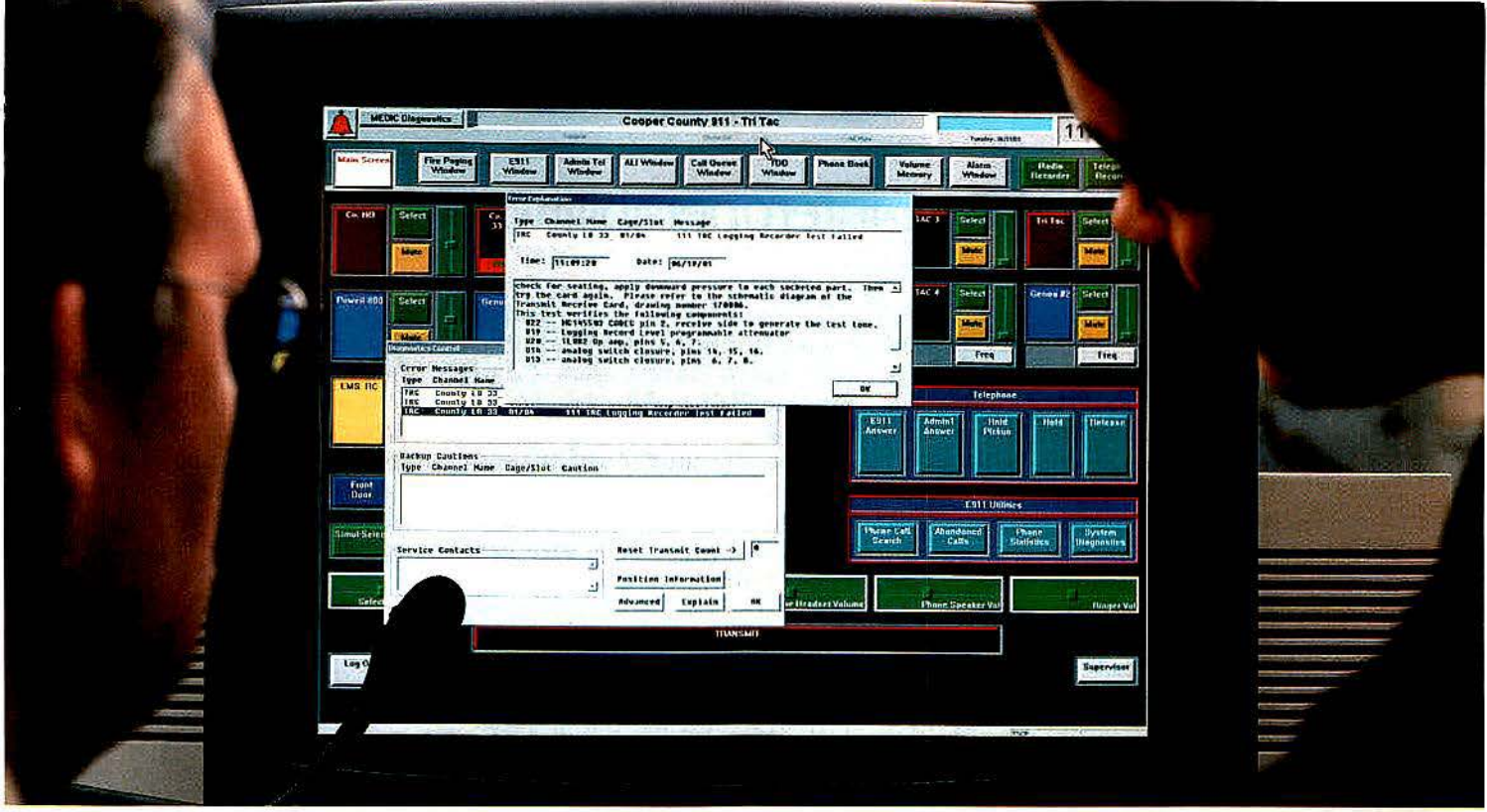

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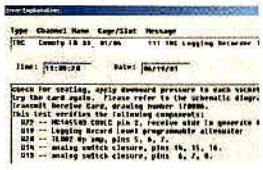

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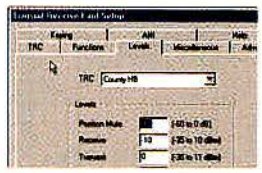

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VHF/800MHz interoperability

By Harold Kinley

Interoperability among various public safety agencies has been a goal of most U.S. states for some time. Many states are still working toward that goal. Many different approaches can be taken to achieve this end. The intended purpose is to allow personnel of various agencies to communicate directly to coordinate efforts on a particular incident. Many agencies and states have spent millions in pursuit of this goal but still find themselves short of total interoperability.

In South Carolina, a Motorola SmartZone 800MHz system is being built to achieve statewide coverage, supposedly. The intended goal is to have every agency (at least those involved with public safety) on this 800MHz system. However, one size does not fit all. The 800MHz system is not the great panacea that it is thought to be by many. Current users of conventional VHF highband radio systems (as well as conventional UHF) are generally satisfied with the coverage these systems provide.

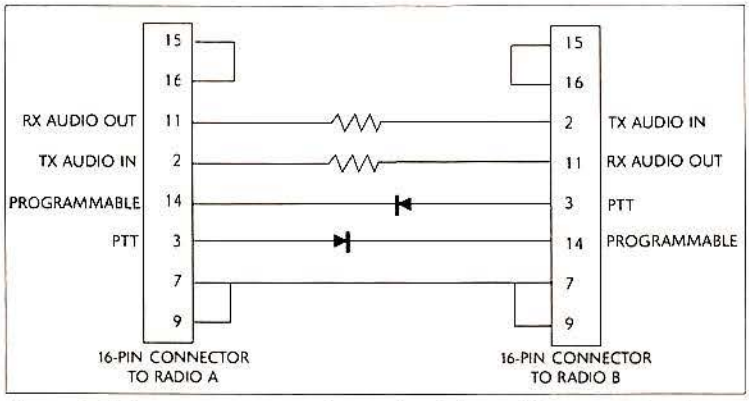

Figure 1: This arrangement can be used to link two Maxtrac 300 radios to form a repeater. The resistors connectors receive audio to transmit audio.

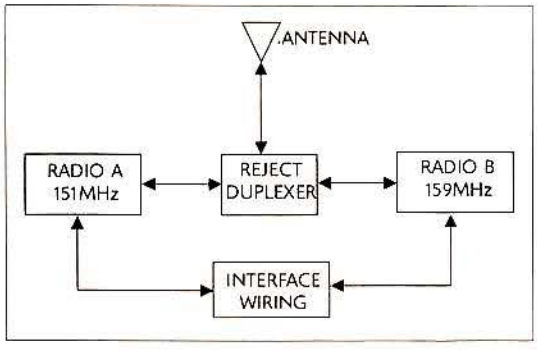

Figure 2: The repeater/translator arrangment is shown here. The duplexer is a mobile-type reject duplexer.

At least one agency that has a VHF highband system also has some radios on the 800MHz trunking system. Most of the comments from those users are negative in regard to the 800MHz system. Instead, they rely on their old VHF system when the message must get through. Running a dual system requires two radios in each installation—an expensive proposition.

Maybe the day will come when all public safety agencies (maybe even non-public safety) will be forced to move to the 800MHz system. And, maybe the completed 800MHz system infrastructure will provide fair radio coverage statewide. Even if that does happen, it will take a long time and lots of money from the agencies involved. So, what to do in the meantime? Let's examine a few options for the short term and maybe even for the long term.

Conventional 800MHz

Certain 800MHz frequencies have been designated for mutual aid on a national basis. These are used in conventional 800MHz operation. A common CTCSS (EIA's *continuous tone coded squelch system*) tone of 156.7Hz is designated for all these frequencies. These standard frequencies are listed in Table 1. The ICALL frequency is used for calling to establish initial contact. Once contact is established, another agreed-upon channel is used for communications.

A few years ago, I built a VHF/VHF repeater or, more aptly, *translator* by configuring and linking two Motorola 16-channel Maxtrac 300 radios. It seemed logical to do the same with a VHF/800MHz conventional setup. Using radios with the 16-pin accessory jack on the rear should be a cinch—I thought. Figure 1 shows how I configured the two VHF Maxtracs to form a repeater/translator. Figure 2 shows how the overall arrangement was configured.

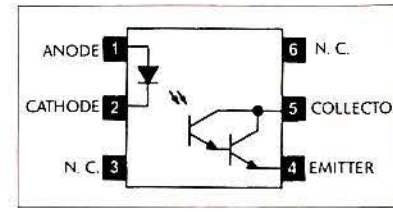

Figure 3: This is the pinout for the ECG3044. When the diode is forward-biased, the light turns on the Darlington phototransistor.

Next, pin 14 on the accessory connector on the rear of each radio was programmed to go low (near ground potential) with the reception of a signal with the proper CTCSS tone. This is done in the radio programming software.

With this setup in mind, I ordered a used 800MHz conventional Maxtrac radio to link with a VHF Maxtrac radio. However, when I received the radio I discovered that I couldn't program the accessory pins because of a software issue. Furthermore, I discovered that my manual didn't cover the logic board in this radio. So now I was flying by the

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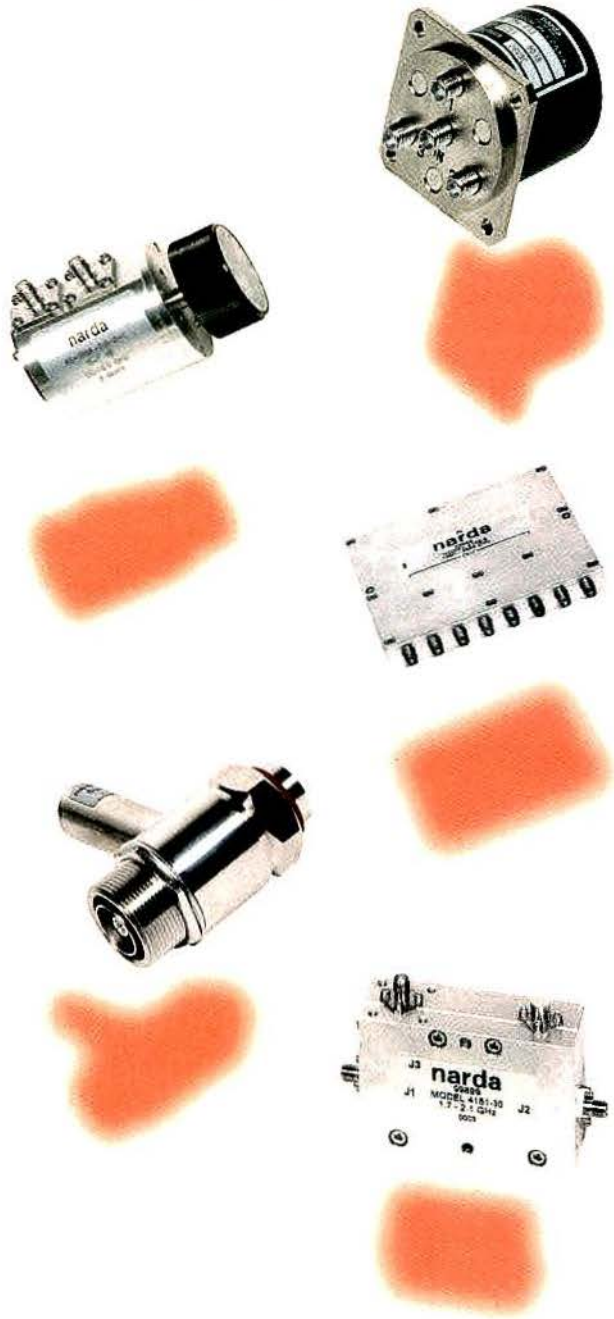

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Table 1: These frequencies have been designated for national use on 800MHz systems to encourage and facilitate interoperability.

Designator	Primary Use	Base Frequency	Mobile Offset
ICALL	Calling (initial contact)	866.0125MHz	−45MHz
ITAC-1	Mutual aid #1	866.5125MHz	−45MHz
ITAC-2	Mutual aid #2	867.0125MHz	−45MHz
ITAC-3	Mutual aid #3	867.5125MHz	−45MHz
ITAC-4	Mutual aid #4	868.0125MHz	−45MHz

seat of my pants.

At this point, it came down to trying to locate a point in the audio/squelch circuitry that would go low with the application of an input signal with the proper CTCSS tone. How hard could it be? Just get out the voltmeter and probe around until I found the right place. So, to begin, I fed the receiver input with a signal at the programmed frequency and with the proper CTCSS tone. While probing with the voltmeter all around the audio/squelch circuitry, I found a point that would go high (near +5V) with the application of the proper signal input and back to low with the removal of the signal—just the opposite of what I wanted. Further probing yielded no better results.

After thinking about it for a while, I decided that this might be a good place to use an optoisolator. Yes, I know I could have used a simple transistor switch by using the +5V through a resistor to forward-bias the transistor. Still, I preferred the optoisolator arrangement.

I recently built a PSK31 interface between my computer and ham radio by using an optoisolator for keying the radio from the computer serial port. The optoisolator prevents ground loops from causing problems and it worked fine in that case.

The optoisolator I used in this project was the ECG3044. The

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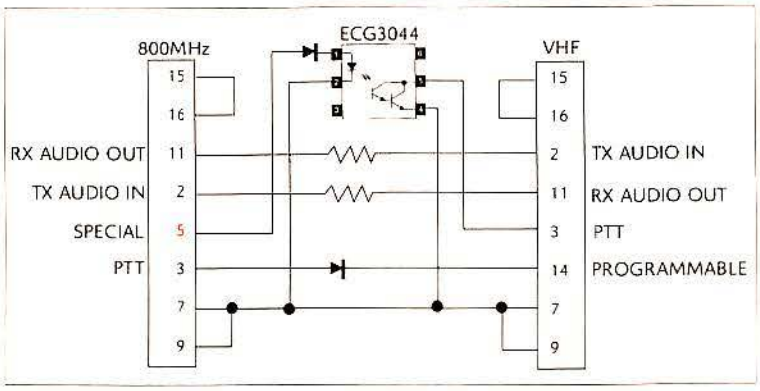


Figure 4: This is the modified arrangement using the ECG3044 optoisolator to key the VHF radio from the 800MHz radio.

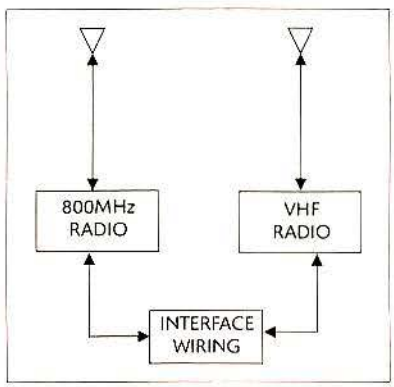
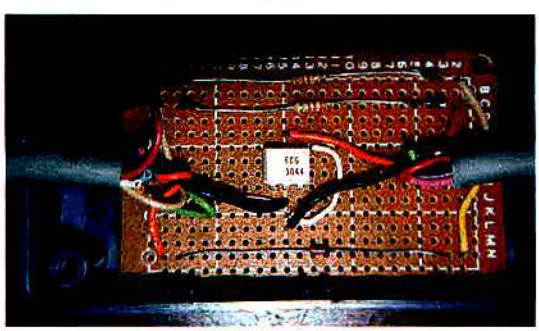


Figure 5: The overall setup of the 800MHz/VHF translator is shown here. No duplexer is used; separate antennas are required.



The wiring of the interface board on a simple perforated project board from RadioShack.

switched transistors are a Darlington pair. (See Figure 3 for the pin connection diagram of the optoisolator.) If you want to see a pdf file on the ECG3044, go to **www.nteinc.com/specs/3000to3099** and click on the pdf beside the 3044. The NTE3044 is the equivalent of the ECG3044. Figure 4 shows the details of the wiring of the interface between the two radios. Notice that pin 5 on the 800MHz radio's 16-pin accessory connector is shown in red. Pin 5 on the radio was disconnected from the normal location in the radio and connected directly to the point on the board that produced the +5V after applying the proper receiver input signal.

When the 800MHz radio receives a signal on frequency and with the proper CTCSS tone (156.7Hz), pin 5 will go high (near +5V). This is applied through a diode to the optoisolator input. The diode inside the optoisolator turns on and produces light. This light turns on the Darlington pair transistor, which places the output (pin 5) at near ground potential. This is applied to pin 3 of the 16-pin accessory connector on the VHF radio, thereby keying the transmitter of the VHF radio.

Receive audio from the 800MHz radio (pin 11) is then fed to the VHF transmitter audio input (pin 2) through the 2.2k resistor. Thus, an 800MHz transmission is heard in VHF receivers tuned to the frequency of the VHF radio in the translator configuration. The setup works bi-directionally. That is why we call it a translator although it is (technically speaking) a repeater.

The photo shows the wiring of the interface board on a simple perforated project board from RadioShack. It is housed in a small plastic box. Figure 5 shows the block diagram of the overall setup. Each radio requires its own antenna—one for 800MHz and one for VHF.

The SmartBridge

The SmartBridge model SB-100 is designed to provide a *gateway* to an 800MHz SmartZone or SmartNet trunking system from a conventional VHF/UHF radio system. The basic operation is similar in nature to the setup previously described but far more sophisticated. A radio base station in the conventional VHF/UHF system is interfaced with an 800MHz trunking radio. For example, for the SmartZone link a Motorola MCS-2000 might be used to serve as the gateway into the 800MHz trunking system.

The SmartBridge SB-100 is from Radio Systems Technologies of Australia. For more information on this product check out the company's Web site at **www.rstradio.com/sb100/sb100datasheet.html.**

The ACU-1000

The ACU-1000 interconnect from JPS Communications of Raleigh, NC, is yet another way to facilitate interoperability. For complete details on this device visit the Web site at **www.jps.com/products/prodinfo/acu1000.html.** For related information on this and other interoperability information visit these Web sites:

- ❑ www.agileprogram.org/documents/acu1000/acu1000memo.html
- ❑ www.agileprogram.org.

Another recommended site is **www.pswn.gov**. Lots of good information on this topic can be found on the Web.

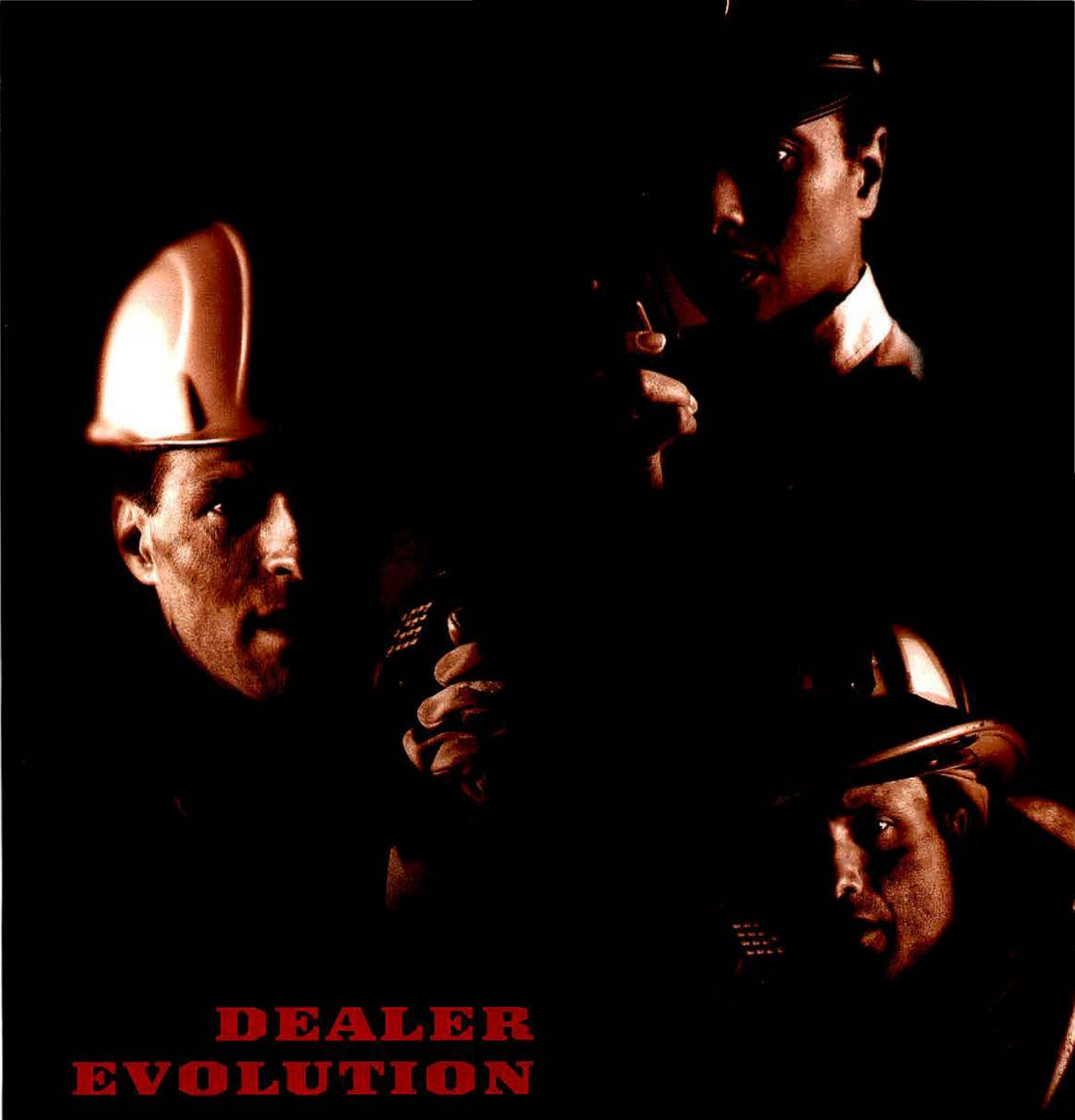
As you can see, many methods can achieve interoperability. These range from the simple translator using mobile radios to fairly sophisticated systems such as those from Radio Systems Technologies and JPS Communications. It is wise to investigate all the options before taking the ultimate plunge. As the old saying goes: "Look before you leap."

Until next time—*stay tuned!* ■

Correction

In the January 2002 "Technically Speaking" column, the interference story submitted by David Parcigneau, radio inspector with the Department of Communications in Montreal, contained an error.

The trunking system to which he referred was not used by the Montreal police, but rather by a regular commercial service provider.



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Is the smart battery a help—or a deterrent?

Explore the advantages and disadvantages of the smart battery that communicates with the charger and user and supports specific applications.

By Isidor Buchmann

A speaker at a battery seminar remarked that, "The battery is a wild animal, and artificial intelligence domesticates it."

An ordinary or "dumb" battery has the inherent problem of not displaying the amount of reserve energy it holds. Neither weight, color nor size provide any indication of the battery's state-of-charge (SoC) and state-of-health (SoH). The user is at the mercy of the battery when pulling a freshly charged battery from the charger.

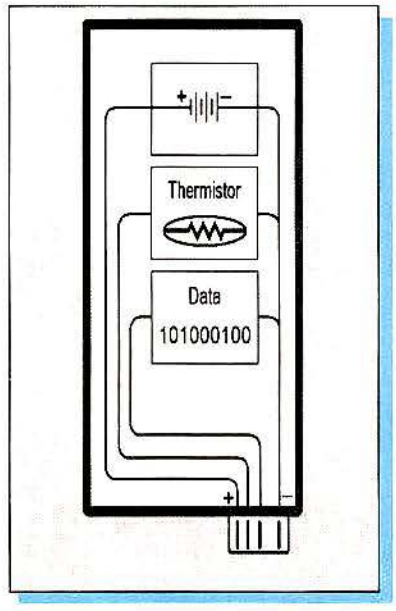

Figure 1: Single-wire system of a 'smart' battery. Only one wire is needed for data communications. Rather than supplying the clock signal from the outside, the battery includes an embedded clock generator. For safety reasons, most battery manufacturers run a separate wire for temperature sensing.

Help is at hand. An increasing number of today's rechargeable batteries are made "smart." Equipped with a microchip, these batteries can communicate with the charger and user alike to provide statistical information. Typical applications for smart batteries are notebook computers and video cameras. Increasingly, these batteries are also used in advanced biomedical devices and defense applications.

There are several types of smart batteries, each offering different complexities, performance and cost. The most basic smart battery may only contain a chip to identify its chemistry and tell the charger which charge algorithm to apply. Other batteries claim to be smart simply because they provide protection from overcharging, under-discharging and short-circuiting. In the eyes of the Smart Battery System forum, however, these batteries cannot be called smart.

What, then, makes a battery smart? Definitions still vary among organizations and manufacturers. The SBS forum states that a smart battery must be able to provide SoC indications. In 1990, Benchmarq was the first company to commercialize the concept of the battery fuel gauge technology. Today, several manufacturers produce chips to make the battery smart.

During the early 1990s, numerous smart battery architectures emerged. They range from the single-wire system, the two-wire system and the system management bus. Most two-wire systems are based on the SMBus protocol.

The single-wire bus

The single-wire system is the simpler of the two and delivers the data communications through one wire. A battery equipped with the single-wire system uses only three wires: the positive and negative battery terminals and the data terminal. For safety reasons, most battery manufacturers run a separate wire for temperature sensing. Figure 1 shows the layout of a single-wire system.

The modern single-wire system stores battery-specific data and tracks battery characteristics, including temperature, voltage, current and remaining charge. Because of simplicity and low hardware cost, the single wire enjoys a broad market acceptance for high-end mobile phones, two-way radios and camcorders.

Most single-wire systems do not have a common form factor; neither do they lend themselves to standardized SoH measurements. This produces problems for a universal charger concept. The Benchmarq single-wire solution, for example, cannot measure current directly; it must be extracted from a change in capacity over time.

On a further drawback, the single-wire bus allows battery SoH measurement only when the host is "married" to a designated battery pack. Such a fixed, host-battery

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relationship is feasible with notebook computers, mobile phones or video cameras, provided the appropriate OEM battery is used. Any discrepancy in the battery type from the original will make the system unreliable or will provide false readings.

The SMBus

The SMBus is the most complete of all systems. It represents a large effort from the portable electronic industry to standardize to one communications protocol and one set of data. The SMBus is a two-wire interface system—one wire handles the data, the second is the clock. It uses the I²C defined by Philips as its backbone.

The Duracell/Intel SBS, which is in use today, was standardized in 1993. In previous years, computer manufacturers developed their own proprietary smart batteries. With the new SBS specification, a broader interface standard is made possible. This reduces the hurdles of interfering with patents and intellectual properties. Figure 2 shows the layout of the two-wire SMBus system.

In spite of the agreed standard, many large computer manufacturers, such as IBM, Compaq and Toshiba, have retained their proprietary batteries. The reason for going their own way is partly due to safety, performance and form factor. Manufacturers claim that they cannot guarantee safe and enduring performance if a non-brand battery is used. To make the equipment as compact as possible, the manufacturers explain that the common form-factor battery does not optimally fit their available space. Perhaps the

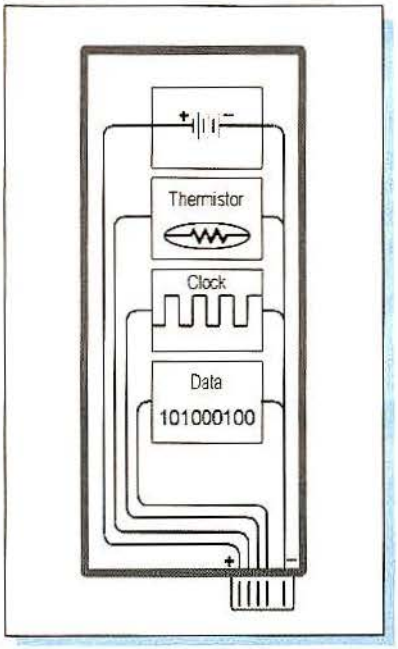

Figure 2: Two-wire SMBus system. The SMBus is based on a two-wire system using a standardized communications protocol. This system lends itself to standardized state-of-charge and state-of-health measurements.

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leading motive for using their proprietary batteries is pricing. In the absence of competition, these batteries can be sold for a premium price.

The objective behind the SMBus battery is to remove the charge control from the charger and assign it to the battery. With a true SMBus system, the battery becomes the master and the charger serves as a slave that must follow the dictates of the battery. This is based on concerns about charger quality, compatibility with new and old battery chemistries, administration of the correct amount of charge currents and accurate full-charge detection. Controlled charging makes sense when considering that some battery packs share the same footprint but contain radically different chemistries.

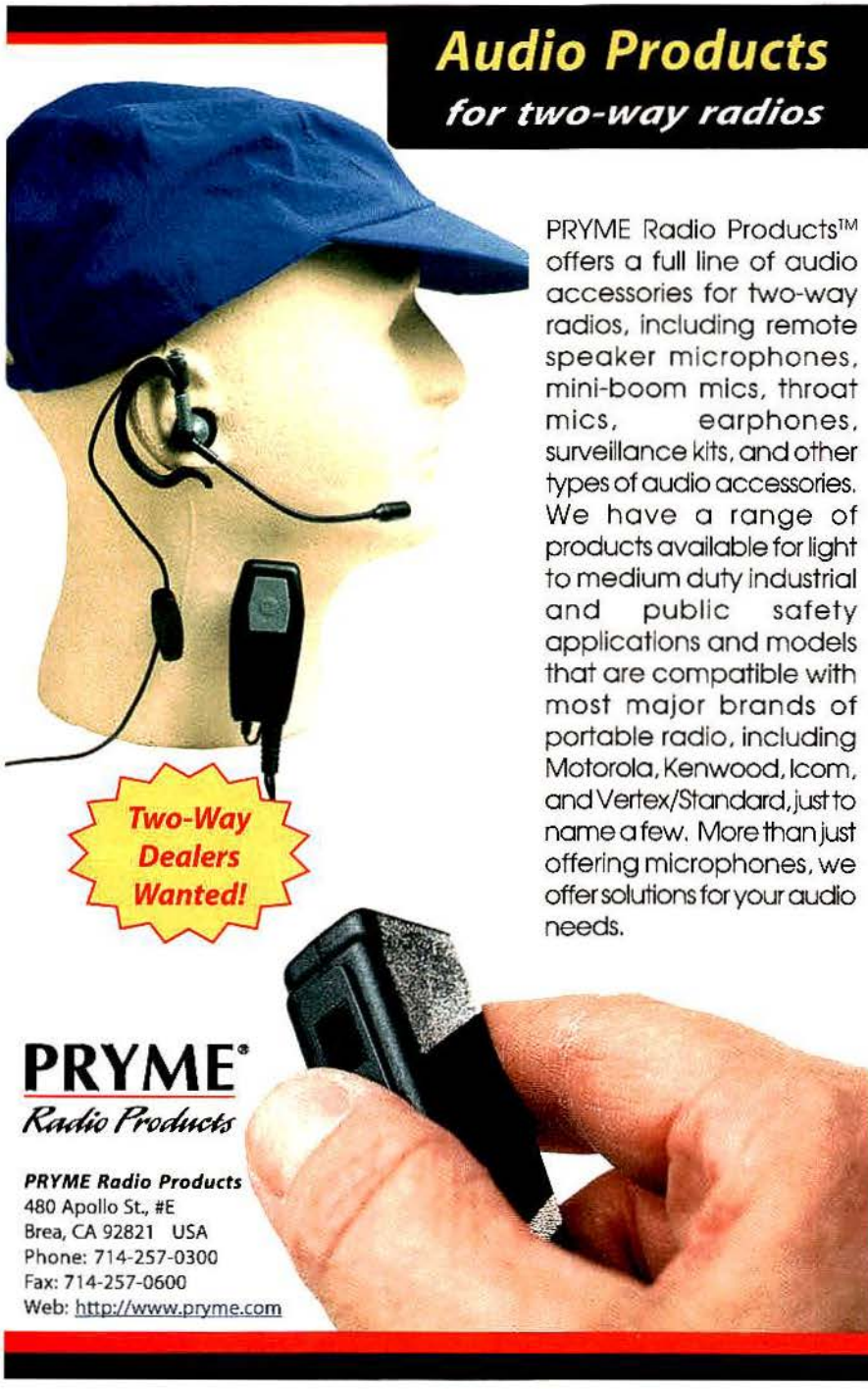
The SMBus system allows new battery chemistries to be introduced without the charger becoming obsolete. Because the battery controls the charger, the battery manages the voltage and current levels, as well as the cut-off thresholds. The user does not need to know which battery chemistry is being used.

An SMBus battery contains permanent and temporary data. The permanent data are programmed into the battery at the time of manufacturing and include battery ID number, battery type, serial number, manufacturer's name and date of manufacture. The temporary data are acquired during use and consist of cycle count, user pattern and maintenance requirements. Some of the temporary data are being replaced and renewed during the life of the battery.

The SMBus is divided into Levels 1, 2 and 3. Level 1 has been eliminated because it does not provide chemistry-independent charging. Level 2 is designed for in-circuit charging. A laptop that charges its battery within the unit is a typical example of Level 2. Another Level 2 application is a battery that contains the charging circuit within the pack. Level 3 is reserved for full-featured external chargers.

External Level 3 chargers are complex and expensive. Some lower-cost chargers have emerged that accommodate SMBus batteries but are not fully SBS-compliant. Manufacturers of SMBus batteries do not readily endorse this shortcut. Safety is always a concern, but customers prefer these economy chargers because of lower price.

Serious industrial battery users



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SS-12	10	12	1⅜ x 6 x 9	3.4
SS-18	15	18	1¾ x 6 x 9	3.6
SS-25	20	25	2⅞ x 7 x 9⅜	4.2
SS-30	25	30	3¾ x 7 x 9⅜	5.0

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SRM-12	10	12	3½ x 19 x 9⅜	4.7
SRM-18	15	18	3½ x 19 x 9⅜	5.0
SRM-25	20	25	3½ x 19 x 9⅜	6.5
SRM-30	25	30	3½ x 19 x 9⅜	7.0

WITH SEPARATE VOLT & AMP METERS

MODEL	CONT. (Amps)	ICS	SIZE (inches)	Wt.(lbs.)
SRM-25M	20	25	3½ x 19 x 9⅜	6.5
SRM-30M	25	30	3½ x 19 x 9⅜	7.0

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SRM-30-2	25	30	3½ x 19 x 9⅜	11.0

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MODEL	CONT. (Amps)	ICS	SIZE (inches)	Wt.(lbs.)
SRM-25M-2	20	25	3½ x 19 x 9⅜	10.5
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SS-18EFJ
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SS-12MC
SS-10MG, SS-12MG
SS-101F, SS-121F
SS-10TK
SS-12TK OR SS-18TK
SS-10SM/GTX
SS-10SM/GTX, SS-12SM/GTX, SS-18SM/GTX
SS-10RA
SS-12RA
SS-18RA
SS-10SMU, SS-12SMU, SS-18SMU
SS-10V, SS-12V, SS-18V

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*ICS – Intermittent Communication Service

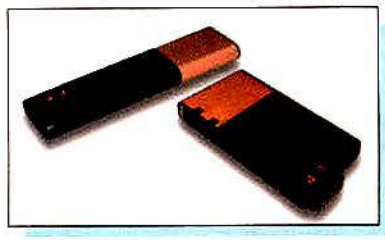

Figure 3: 35 and 202 series smart batteries featuring SMBus. Available in NiCd, NiMH and Li-ion chemistries, these batteries are used for laptops, biomedical instruments and survey equipment. A non-SMBus (dumb) version with same footprint is also available.

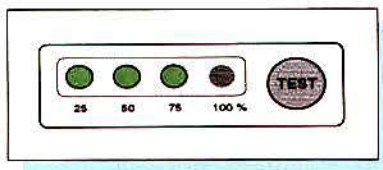

Figure 4: State-of-charge readout of a 'smart' battery. Although the state-of-charge is displayed, the state-of-health and its predicted run time are unknown.

operating biomedical instruments, data collection devices and survey equipment use Level 3 chargers with full-fledged charge protocol. No shortcuts are applied. To ensure compatibility, the charger and battery are matched, and only approved packs are used. The need to test and approve the marriage between a specific battery and charger is unfortunate given that the smart battery is intended to be universal.

Among the most popular SMBus batteries for portable computers are the 35 and 202 form factors. Manufactured by Sony, Hitachi, GP Batteries, Moltech, Moli Energy and many others, this battery works (should work) in all portable equipment designed for this system. Figure 3 illustrates the 35 and 202 series smart batteries. Although the 35 has a smaller footprint compared to the "202," most chargers are designed to accommodate all sizes. A non-SMBus (dumb) version with same footprint is also available.

Negatives of the smart battery

As does any good invention, the smart battery has some serious downsides. For starters, the smart battery, especially the SMBus, costs about 25% more than the dumb equivalent. In addition, the smart battery was intended to simplify the charger, but a full-fledged Level 3 charger costs substantially more than a regular dumb model.

A more serious issue is maintenance requirements, better known as capacity re-learning. This is needed on a regular basis to calibrate the battery. The engineering manager of Moli Energy, a large Li-ion cell manufacturer, commented, "With the Li-ion battery, we have eliminated the memory effect, but are we introducing digital memory with the SMBus battery?"

Why is calibration needed? The answer is to correct the tracking errors that occur between the battery and the digital sensing circuit during use. The most ideal battery use, as far as fuel-gauge accuracy is concerned, is a full charge followed by a full discharge at a constant 1C rate. In such a case, the tracking error reduces to less than 1% per cycle. In real life, a battery might be discharged for only a few minutes at a time and more commonly at a lower C-rate than 1C. Worst of all, the load may be uneven and vary drastically. Eventually, the true capacity of the battery no longer synchronizes with the fuel gauge, and a full charge and discharge is needed to re-learn or calibrate the battery.

How often is calibration needed? The answer lies in the type of battery application. For practical purposes, a calibration is recommended once every three months or after every 40 short cycles. Long storage also contributes to errors because the circuit cannot accurately compensate for self-discharge. After extensive storage, a calibration cycle is recommended prior to use.

Many applications apply a full discharge as part of regular use. If this occurs regularly, no additional calibration is needed. If a full discharge has not occurred for a few months and the user notices the fuel gauge losing accuracy, a deliberate full discharge on the equipment is recommended. Some intelligent equipment advises the user when a calibrating discharge is needed. This condition is revealed by measuring the tracking error and estimating the discrepancy between the fuel gauge reading and that of the chemical battery.

What happens if the battery is not calibrated regularly? Can such a battery be used in confidence? Most smart battery chargers obey the dictates of the cells rather than the electronic circuit. In this case, the battery will be fully charged regardless of the fuel gauge setting. Such a battery can function normally, but the digital readout will be inaccurate. If not corrected, the fuel gauge information simply becomes a nuisance.

The level of non-compliance is another problem with the smart battery, in particular the SMBus. Unlike other tightly regulated standards, the SMBus protocol allows some variations. This may cause problems with existing chargers, and the SMBus battery should be checked for compatibility before use. Ironically, the more features that are added to the SMBus charger and battery, the higher the likelihood of incompatibilities.

The state-of-charge indicator

Most SMBus batteries are equipped with a charge level indicator. When pressing an SoC button on a battery that is fully charged, all signal lights illuminate. On a partially discharged battery, half the lights illuminate, and on an empty battery, all lights remain dark. Figure 4 shows such a fuel gauge.

While SoC information displayed on a battery or computer screen is helpful, the fuel gauge resets to 100% each time the battery is recharged, regardless of the battery's SoH. A serious miscount occurs if an aged battery shows 100% after a full charge, when in

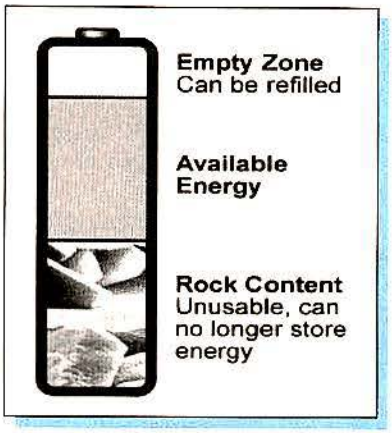

Figure 5: Battery charge capacity. Three imaginary sections of a battery consisting of available energy, empty zone and rock content. With use and age, the rock content grows. Without regular maintenance, the user may end up carrying rocks instead of batteries.

fact the charge acceptance has dropped to 50% or less. The question remains: "100% of what?" A user unfamiliar with this battery has little information about the runtime of the pack.

The tri-state fuel gauge

The battery cannot be evaluated without knowing its state-of-health. Three information levels are needed: SoC, SoH and the empty portion that can be refilled. Figure 5 illustrates the three imaginary sections consisting of the empty zone, available energy and rock content.

How can the three levels of a battery be measured and made visible to the user? While the SoC is relatively simple to produce, measuring the SoH is more complex. Here is how it works:

At the time of manufacture, each SMBus battery is given its specified SoH status, which is 100% by default. This information is permanently programmed into the pack and does not change. With each charge, the battery resets to the full-charge status. During discharge, the energy units (coulombs) are counted and compared against the 100% setting. A perfect battery would indicate 100% on a calibrated fuel gauge. As the battery ages and the charge acceptance drops, the SoH begins to indicate lower readings. The discrepancy between the factory-set 100% and the actual delivered coulombs is used to calculate the SoH.

Knowing the SoC and SoH, a simple linear display can be made. The SoC is indicated with green LEDs; the empty part remains dark; and the unusable part is shown with red LEDs. Figure 6 shows such a tri-state fuel gauge.

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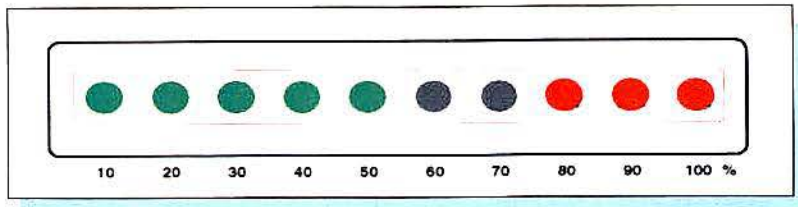

Figure 6: Tri-state fuel gauge. The Battery Health Gauge reads the 'learned' battery information available on the SMBus and displays it on a multicolored LED bar. The illustration shows a partially discharged battery of 50% SoC with a 20% empty portion and an unusable portion of 30%.

Figure 7. This Level 3 charger serves as charger, conditioner and quality-control system. It reads the battery's true state of health and flags those that fall below the set target capacity. Each bay operates independently and charges NiCd, NiMH and Li-ion chemistries in about three hours. Dumb batteries can also be charged, but no SoH information is available.

As an alternative, the colored bar display may be replaced with a numeric display indicating SoH and SoC. The practical location to place the tri-state fuel gauge is on the charger.

The target capacity selector

For users that simply need a go/no-go answer, chargers are available that feature a target capacity selector. Adjustable to 60%, 70% or 80%, the target capacity selector acts as a performance check and flags batteries that do not meet set requirements.

If a battery falls below target, the charger triggers the condition light. The user is prompted to press the condition button to calibrate and condition the battery by applying a charge/discharge/charge cycle. If the battery does not recover, the fail light illuminates, indicating that the battery should be replaced. A green ready light ensures that the battery meets the required performance level. Figure 7 illustrates a two-bay Cadex charger featuring the target capacity selector and discharge circuit. This unit is based on Level 3 and services both SMBus and dumb batteries. SoH readings are only available when servicing SMBus batteries.

By allowing the user to set the desired battery performance level, the question is raised as to what level to select. The answer is governed by the applications, reliability standards and cost policies.

A practical target capacity setting for most applications is 80%. Decreasing the threshold to 70% will lower the performance standard but pass more batteries. A direct cost saving will result. The 60% level may suit those users who run a low-budget operation, have ready access to replacement batteries and can live with shorter, less predictable run times. It should be noted that the batteries are always charged to 100%, regardless of the target setting. The target capacity simply refers to the amount of charge the battery has delivered on the last discharge.

SMBus battery technology is predominantly used for higher-level industrial applications. Improvements in the smart battery system, such as higher accuracies and self-calibration will likely increase the appeal of the smart battery. Endorsement by large software manufacturers such as Microsoft will entice PC manufacturers to make full use of these powerful features.

Smart battery technology has not received the widespread acceptance that battery manufacturers had hoped. Some engineers go so far as to suggest that the SMBus battery is a "misguided principle." Design engineers may not have fully understood the complexity of charging batteries in the incubation period of the smart battery. Manufacturers of SMBus chargers are left to clean up the mess.

One main drawback of the smart battery is high price. In the early 1990s, when the SMBus battery was conceived, price may not have been as critical as it is today. Now, buyers want scaled-down products that are economically priced and perform the function intended. In the competitive mobile phone market, for example, the features offered by the SMBus would be considered overkill.

Despite teething problems and relatively high costs, the smart battery will continue to fill a critical market segment. Unless innovative improvements are made and manufacturing costs are drastically reduced, this market will be reserved for high-level industrial applications only. ■

This article contains excerpts from the second edition book entitled *Batteries in a Portable World — A Handbook on Rechargeable Batteries for Non-Engineers*. In the book, Buchmann evaluates the batteries in everyday use and explains their strengths and weaknesses in laymen's terms. The 300-page book is available from Cadex Electronics through *book@cadex.com*, tel. 604-231-7777 or most bookstores. For additional information on battery technology visit www.buchmann.ca.

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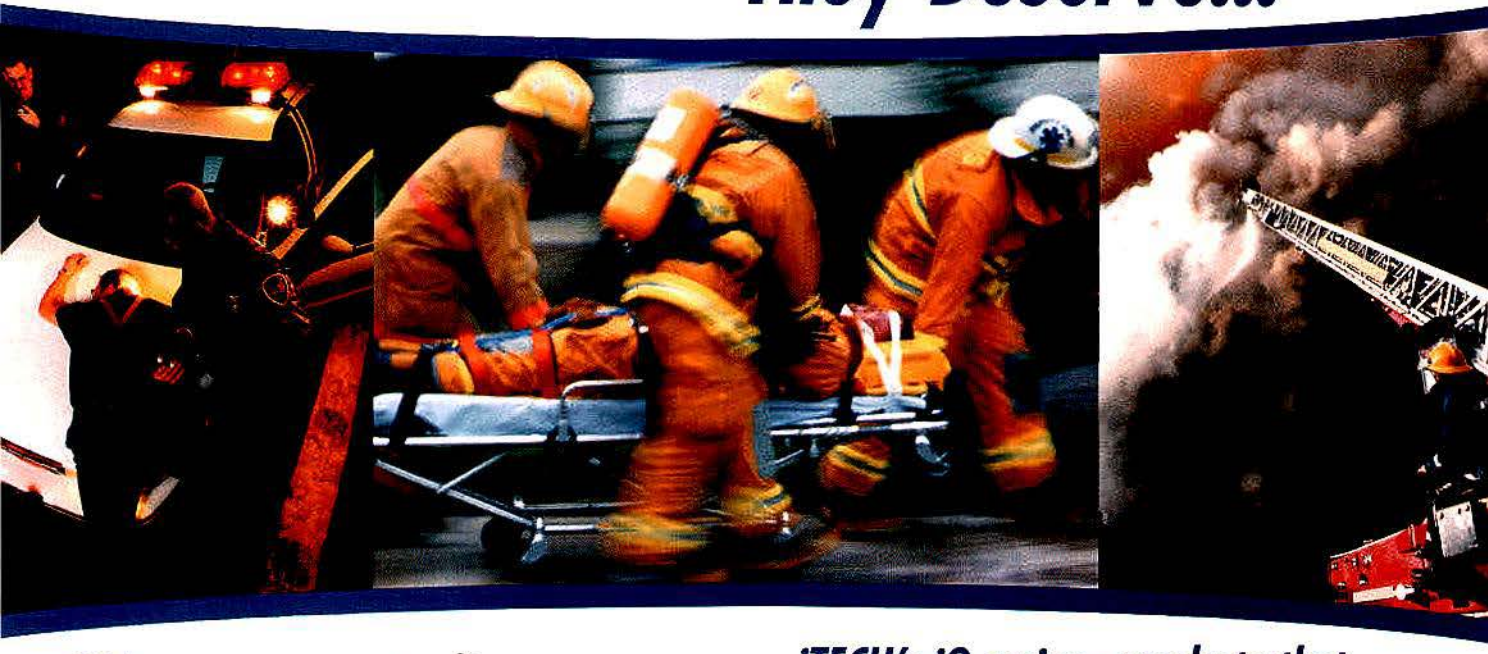

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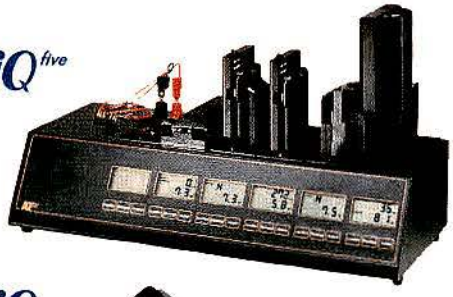

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Failure to communicate

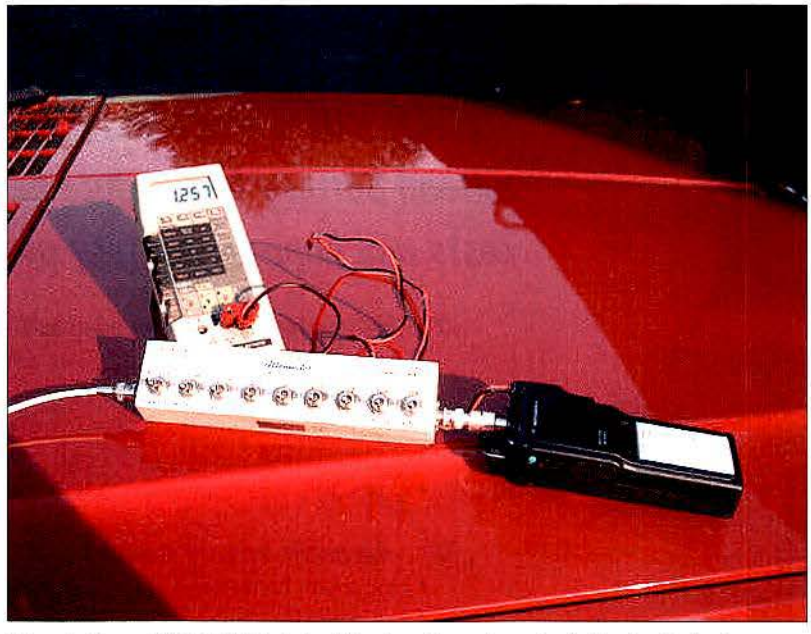
Working on an 18-month timetable vs. Nextel's six-month plan, APCO's Project 39 committee catalogs 800MHz interference issues, seeks practical short-term and long-term solutions—and needs funding.

By Don Bishop

When police officers cannot use their 800MHz radios to call for back-up and firefighters are unable to use their radios to communicate across short distances separating them, it brings attention to shortcomings in radio communications.

Sometimes the communications failures can be traced to inadequate system design. But when public safety radio communications fail because of interference from other radio communications systems, including commercial digital radio systems and cellular systems, interference resolution becomes a high priority.

"Commercial digital systems" usually means cellular-style networks operated by Nextel Communications, Reston, VA, and "cellular systems" are those operated on the A and B frequency bands above the 800MHz public safety frequency bands.



Mounted on a WCCCA Technical Services Department vehicle, the test set-up was positioned 300 yards from each cell site to measure the RSSI voltage in the portable transceiver as an indication of intermodulation interference.

In April 2001, the Association of Public-Safety Communications Officials—International formed the Project 39 Committee with the mission to provide multiple solutions at six-month, 12-month and 18-month benchmarks. The committee first met in August 2001 at the APCO national conference. In December 2001, the committee filed an interim report with the FCC that detailed short-term solutions that have proven effective.

Bishop is editorial director. His email is *dbishop@primediabusiness.com*.

Long-term solution

Project 39 and Nextel are also seeking a long-term solution. In November 2001, Nextel asked the FCC to initiate a six-month proceeding to adopt new regulations that would reallocate radio spectrum among various users in a way that the company said could resolve the interference. Project 39's goals include cataloging current interference within six months and identifying short-term solutions within 12 months and long-term solutions within 18 months.

The interim report detailed interference in 28 states. The chairperson, RoxAnn Brown, said that the committee is attempting to verify each and every interference report.

Brown consults the Washington County Consolidated Communications Agency in Beaverton, OR, where she served as the agency's director for more than six years before resigning in December 2001. WCCCA has extensive experience with interference from Nextel. Its technical systems manager, Joe Kuran, can be credited with first identifying Nextel signals as an interference source.

Brown has praised Nextel for implementing an effective short-term solution for the benefit of WCCCA. Kuran has detailed in the

interim report a modification to the Motorola MTS2000 radio that reduces its internally generated intermodulation interference.

Brown said that Nextel has reduced its cell site transmitter power in some locations by as much as 70% and has selectively removed channels it uses to eliminate interference to WCCCA system users. She said that WCCCA was surprised to learn that sideband noise from Nextel transmitters was not the primary cause of interference, nor was receiver overload. Receiver-generated intermodulation products account for most of the interference—although when it is eliminated, remaining sideband noise and receiver desensitization are sometimes evident.

Receiver-generated intermod

In the interim report, Kuran described the classic use of antenna input attenuation to confirm receiver-generated intermodulation products. Nextel has characterized a solution involving power reduction and channel use limitations as "short-term." Kuran reported that Nextel limited its operations in this way at 200 sites in the WCCCA service area.

With Nextel's exclusive contribution to receiver-generated intermodulation interference under control, WCCCA found that Nextel and A-band AT&T Wireless signals from cell sites within a quarter mile of each other mix in the public safety receivers to cause the same problem.

Brown said that AT&T Wireless initially seemed reluctant to negotiate a solution. But when she told the AT&T Wireless representative that Nextel's connection with public safety radio interference had been profiled on the front page of *USA Today* and that "AT&T Wireless could be next; all of a sudden, they came to the table," she said.

Kuran also found that substituting a seven-cent capacitor for a PIN diode in the MTS2000 reduces the receiver-generated interference by 7dB to 10dB, a significant improvement.

Yet receiver improvements do not seem to hold the key to resolving the interference. Kuran pointed out that the receiver meets high-quality standards with an intermodulation specification of 70dB. A higher specification would be impractical unless a user would submit to carrying an external battery pack to power a high-power injection oscillator in the receiver.

The prospect of shortened battery life overrules sharper filters that might narrow a front end

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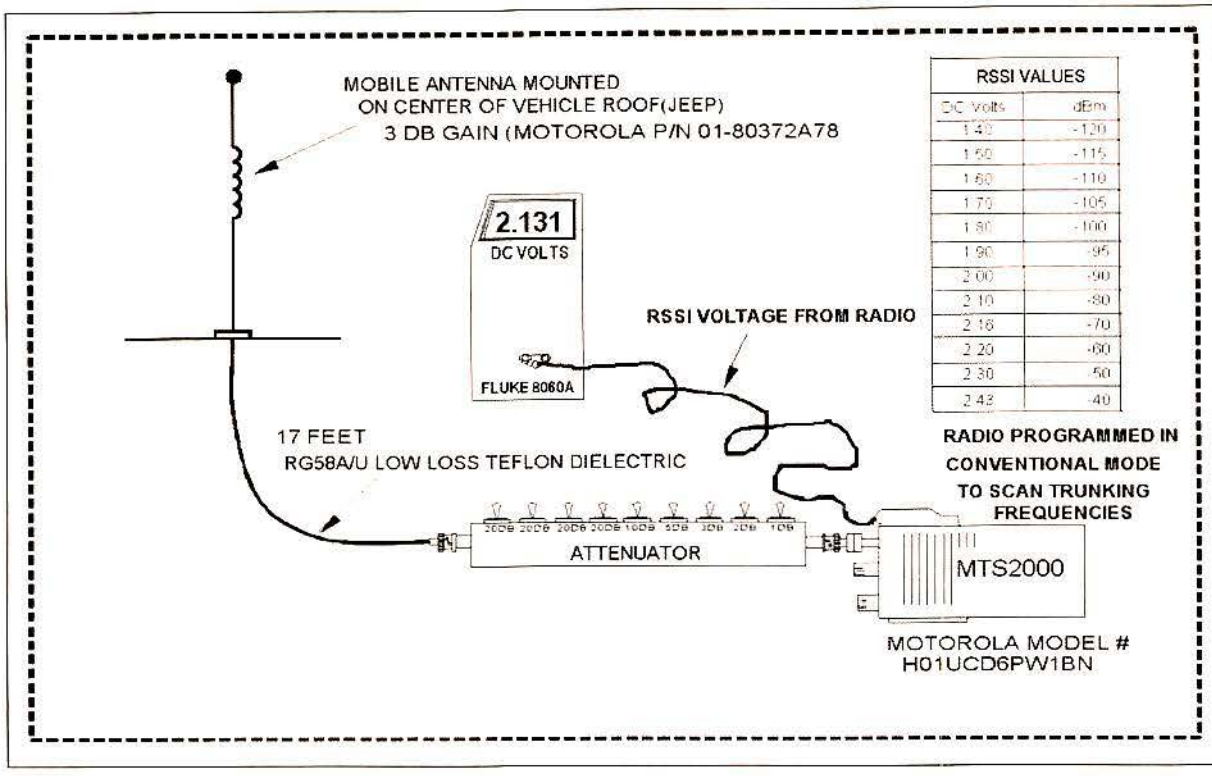

Figure 1. The test set-up Joe Kuran used to measure receiver-generated intermodulation interference in the Motorola MTS2000 portable transceiver found that an RSSI voltage of 1.7 or greater indicated the radio was getting hit with high-level intermodulation.

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Positions on 800MHz interference resolution

Nextel Communications would move its systems to the NPSPAC frequencies; move public safety systems to the lower end of the 800MHz band, double its allocation, and pay $500 million of its expenses; change the status of business, industrial/land transportation and non-cellular SMR systems at 800MHz to "secondary" while offering them replacement spectrum at 700MHz and 900MHz with relocation at their own expense—and Nextel would receive 10MHz in the 2.1GHz mobile satellite band reallocated for cellular use.

Seven trade associations representing public safety organizations characterize Nextel's proposal as a "major step in the right direction" and call on the FCC to give it "serious and expedited consideration."

Daigneault Communications and the *Licensing Assistance Office* ask that the FCC put the Nextel proposal on public notice and then issue a Notice of Inquiry seeking comment. About Nextel's desire to have a reallocation of frequencies codified in the FCC rules within six months, Daigneault and LAO suggest: "It is not clear, however, that such a hasty implementation would serve the public interest."

Washington attorney *Dennis C. Brown* suggests that all 800MHz systems, including public safety, be reclassified as "commercial," which would allow Nextel the opportunity to negotiate buy-outs, frequency swaps or other alternatives at prices acceptable to incumbents.

The *National Association of Manufacturers* and the *Manufacturers Radio Frequency Advisory Committee* prefer that public safety be given the lower end of the 800MHz band, business users the middle of the band and Nextel the upper end, to minimize frequency relocation expense.

Milbank Communications, Milbank, SD, urges the FCC to reject Nextel's proposal, noting that Nextel has yet to complete a previous system relocation plan. Gene Johnsen asks that any solution "not result in the wholesale eviction of private wireless systems from the 800MHz band."

United Airlines estimates it would cost $2 million or more to relocate its Denver International Airport radio system to the 700MHz or 900MHz band and points out that no suitable equipment is available for the 700MHz and that the 900MHz band is overcrowded.

Kay Communications, Sulphur, LA, says it would have to go out of business if faced with the $1 million expense of replacing its petrochemical and public safety customers' radios, and questions Nextel's ability to supply replacement spectrum in the 700MHz and 900MHz bands in the first place. "Nextel's current licensing assignments in these bands are not available on a nationwide basis," Kay's letter to the FCC reads.

Taxi Equipment Company, Gardena, CA, echos the comments of Milbank, United Airlines and Kay, and places its system relocation expense at $2 million.

Pegasus Guard Band LLC, licensee of 34 guard band authorizations in the 700MHz band, despite having no discernable plan for using its frequencies, protests that Nextel's plan would alter the equipment supply for the guard band and the demand for services.

Boeing puts its relocation cost at $50 million and, as a mobile satellite licensee, objects to a reallocation of mobile satellite frequencies to Nextel to use for cellular service. Boeing supports the NAM/MRFAC plan and forecasts the submission of other acceptable alternatives.

Motient, Reston, VA, says: "Incredibly, Nextel's plan fails to address Motient and how the needs of its 250,000 customers will be met while essentially requiring Motient to pay the price—a very steep price—for the interference sins of others."

designed to receive 851MHz–869MHz. The filter response doesn't roll off much below 880MHz, leaving it more open to A-band cellular signals.

"The better the filter, the shorter the battery life. Public safety likes to see a 10-hour battery life," Kuran said in the interim report.

Brown at PSWN

Speaking to an audience at the Public Safety Wireless Network conference in Charleston, SC, on Jan. 30, Brown identified some additional points involving the interference problem.

She acknowledged Nextel's white paper that proposes a wholesale reallocation of public safety, commercial, business, industrial/land transportation and mobile satellite frequencies. She described APCO as "cautiously optimistic" and discounted published articles that said a public safety coalition supports the reallocation proposed in the white paper.

Brown said the public safety community has sought contiguous spectrum since the 1980s. She said the plan embodied in the white paper offers contiguous spectrum, but not necessarily in the right way or in the only way.

"We want the FCC to issue a Notice of Proposed Rulemaking, and then we can beat the heck out of it. As long as we merely write letters to the FCC about the interference, what do we get repaired? Not much," she said.

Brown said that the APCO Web page that has been used to collect data related to the interference problem doesn't ask all of the questions for which the Project 39 committee needs answers.

Ron Hasareth, APCO's staff liaison to the committee, confirmed that lack of funding has hampered efforts to construct a new Web page. Brown said that APCO has spent about $52,000 so far on Project 39, despite the fact that APCO had not budgeted for the committee's expenses.

"We're off to a good start, and we've accomplished a lot in short time. We can do it in two years, but we have to fund it," Brown said. "We don't want this thing to drag on."■

Technical techniques: A primer for transmission lines

Part II—An understanding of transmission lines and tips on using them as transformers and filters can help techs properly configure feedlines and even solve some problems.

By Patrick E. Buller

One of the most fascinating types of transmission lines is the *waveguide*. Radio waves—if confined within a hollow tube of conducting material and if the dimensions of the tube are appropriate for the frequency of operation—will travel the length of the tube with little loss. Such a tube is a waveguide. It comes in three physical forms: rectangular, elliptical and circular.

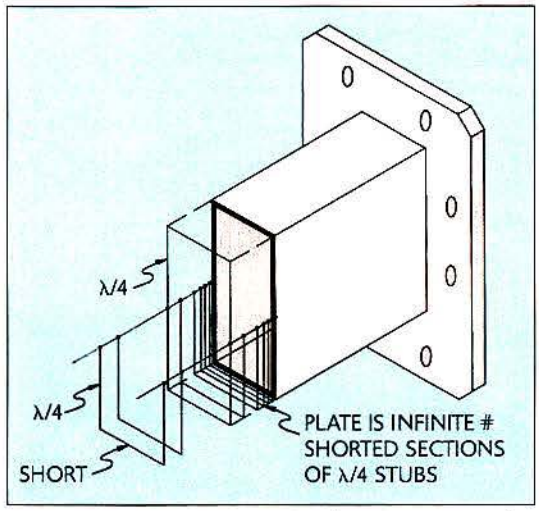


Figure 1. Waveguide–derivation from two-wire balanced line.

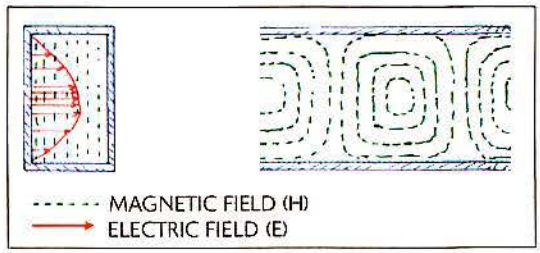


Figure 2. Field configuration for a TE 10 wave.

Rigid waveguide

Rectangular is the most common waveguide form in the radar industry. Elliptical is used for terrestrial microwave. Circular was most popular for the long-haul, high density, point-to-point microwave service such as AT&T. Radio energy travels within this confined area by reflecting off the sidewalls of the guide. The reflections occur so that the electric and magnetic fields of the waves set up a definite pattern within the guide. These patterns are called *modes*.

In addition, every mode has a *cutoff frequency*. This is the lowest frequency that will propagate down the waveguide. The lowest frequency that can travel through the waveguide is called the *dominant mode*. A dominant mode is the frequency that has a wavelength equal to twice the width of the guide. This mode has the simplest field pattern and is not as susceptible to impedance mismatches and reflections as the more complex modes. Usually, a rectangular guide has a width greater than half a wavelength but no more than one wavelength, and the height is half this width.

A rectangular waveguide can be thought of as a special case of a two-wire transmission line supported by quarterwave shorted stubs as shown in Figure 1. The voltage is a maximum at the center point corresponding to the imaginary two wires and a voltage minimum at the shorted ends.

Figure 2 shows the transverse electrical TE 10 mode. It's characterized by the fact that the electric vector (E vector) is always perpendicular to the direction of propagation. Note that the electric "E" field exists within the waveguide and is maximum in the center and zero at the ends. From this we can see that the "E" field is the voltage field.

Energy is inserted or removed by a simple probe spaced a quarter-wavelength from a shorted end of waveguide and at the center of the guide as shown in Figure 3. The probe is considered a quarterwave antenna with ground plane because the entire waveguide is made of conductive material, usually oxygen-free high conductivity copper. Remember, to make an antenna broadband, increase its diameter or add capacity. Most coax-to-waveguide adaptors have the quarterwave antenna captured in a polystyrene tube that not only fixes the probe, but also adds a sufficient amount of capacity making it a broadband antenna.

A contributing factor of *efficient* wave propagation within a hollow waveguide is not having any abrupt change in the physical dimensions. In other words, dents or foreign material within the waveguide disturb the E and H field causing reflections that result in a standing wave pattern. Any system using a waveguide is most

Buller is a special projects engineer for Tacoma Power, Tacoma, WA. For many years, he served as an electronics design engineer for the Washington State Patrol. He is a member of IEEE, NARTE, APCO and ARRL, and he is a Fellow of the Radio Club of America. His email address is *W7rqt@msn.com*.

vulnerable to damage here. A sign often seen on radar installations is "Warning-Waveguide-Do not chip or dent." This warning is valid whether the waveguide is circular, rectangular or elliptical.

An exception to this rule is when probes are installed for tuning purposes. A machine screw installed in the center of the guide will either add capacity or inductance, depending on its placement within the VSWR pattern. Once the "E" field is disturbed, it remains disturbed all along the line until it reaches another point of opposite disturbance where it can be canceled. Tuning screws are frequency dependent and will have different effects depending on where they're placed, not only along the line but how deeply they penetrate. Small dents appropriately placed on a rigid waveguide can add opposite reactive components that cancel those within the waveguide. The experienced person can *tune* a waveguide by carefully applying pressure at precise points along a waveguide while observing the return loss. Waveguide components such as the E and H bends often have a decal near distortions stating "dent tuned," meaning, don't call us because of apparent damage.

Adding several tuning screws close together ensures tuning ability for either kind of reactance. Tunable elliptical waveguide connectors have tuning screws where the transition is from elliptical to rectangular. These tuning screws take care of the connecter discontinuities and do little for transmission line discontinuities many wavelengths away.

By observing the H field of

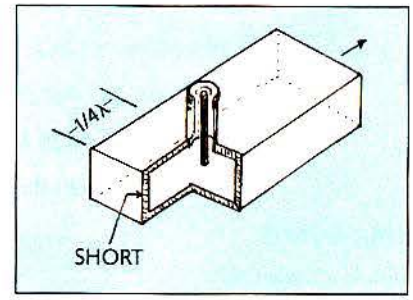


Figure 3. Cut-away showing probe coupling to waveguide.

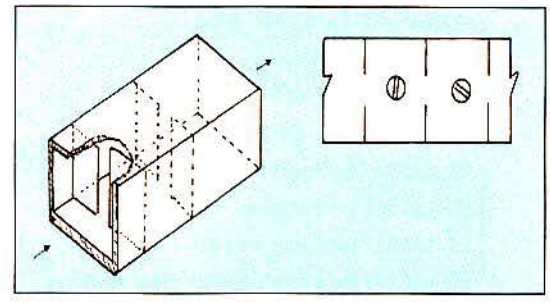
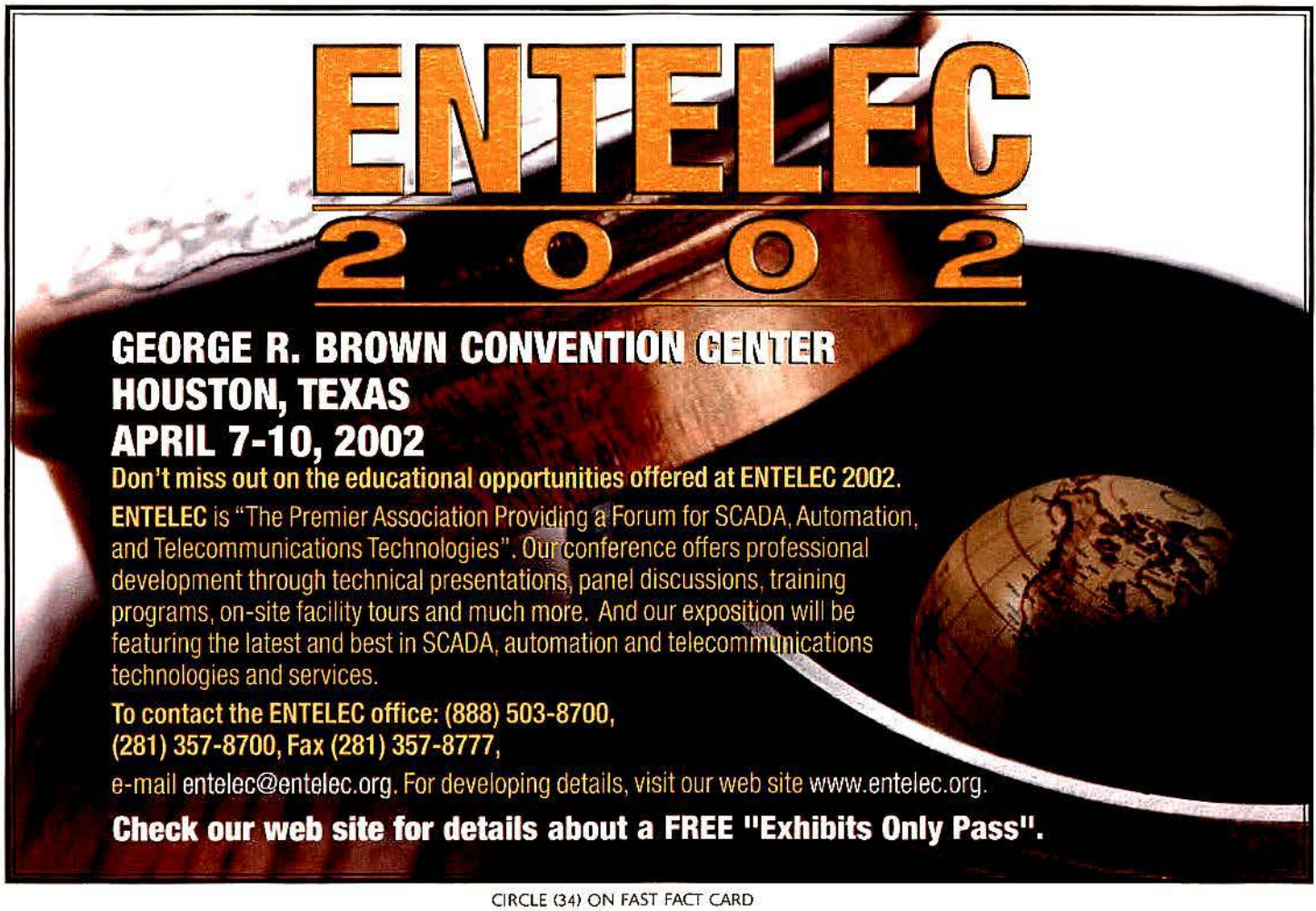


Figure 4. Resonant cavity from waveguide.



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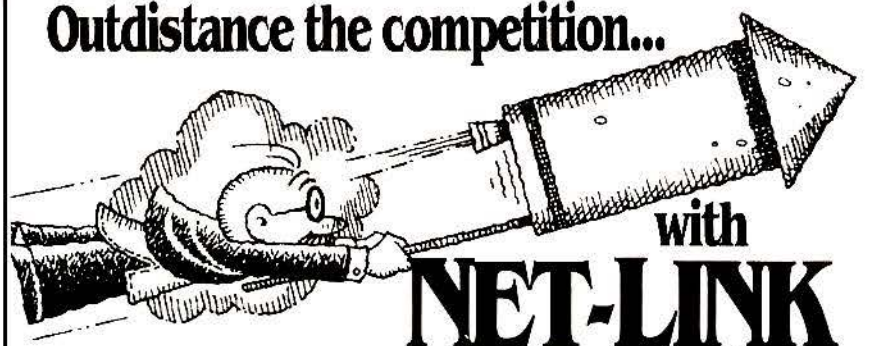

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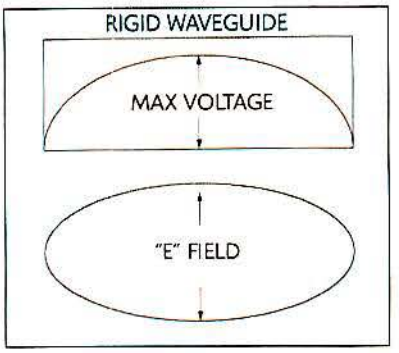


Figure 5. Elliptical waveguide follows voltage gradient.

Figure 2, we see that this field has a definite pattern. If the interior of the waveguide had walls spaced identical to the field pattern, a cavity could be made out of this guide. Indeed that is what is done. Walls placed within the guide (as shown in Figure 4) add inductance, and a tuning screw adds capacity that will tune this area to a specific (waveguide) frequency. Energy travels from one compartment to the other (aperture coupling), but only at a frequency that is resonant to the E × H field.

This method of tuning a waveguide is usually used for "front ends" of a microwave transceiver. Its bandwidth is a function of how many "rooms" and how large the door is between rooms.

As in coax transmission lines, waveguide transmission line cavities described above have low "Q" values, (less than 50), meaning it's a broadband device. High Q values cannot be obtained with waveguide dimensions and are constructed as large cylinders connected to the waveguide. High Q values are required for reference oscillators or AFC cavities.

Elliptical waveguide

Elliptical waveguide is an efficient modification of rigid or rectangular waveguide. Its physical shape tends to follow the "E" field shown in Figure 5. The advantage of the elliptical waveguide is manufacturing convenience. It's composed of a strip of copper that is corrugated, folded over, welded and jacketed. It's available in continu-

ous lengths up to shipping limits of around 3,000 feet. The only joints are the connectors on each end. Elliptical waveguides can be bent in either the E or H plane without hardship or damage. Rigid, on the other hand, was limited to 20-foot lengths requiring choke and cover flanges at each 20-foot distance. Prefabricated 90° bends were needed (two more flanges) to change directions.

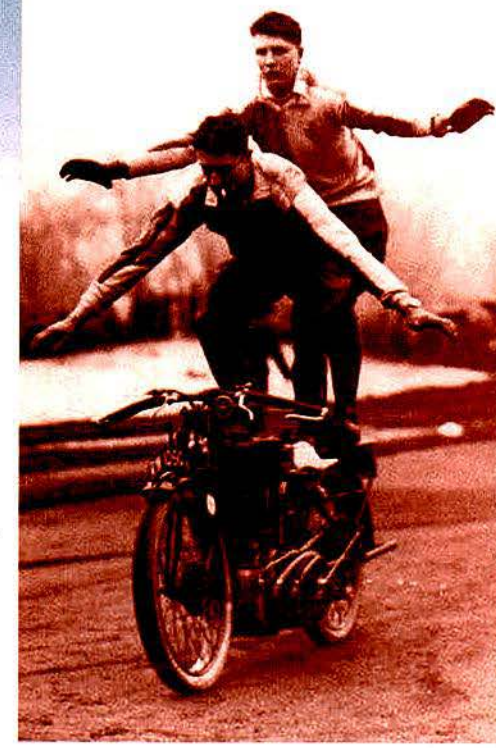
All hollow waveguides need air under pressure (3psi–5psi) to prevent moisture migration to the inside. Any leak allows air to escape and prevents moisture from getting in. For high-power installations, 15psi of pressure or more raises the voltage level that the waveguide will handle without internal arc-over.

Circular waveguide

A circular waveguide is perfectly symmetrical and, as with a rigid guide, the inside must be free of imperfections such as dents and foreign material. A circular guide can handle circular, horizontal or vertical polarizations. The only difference is the way energy is fed and removed from the guide. It is preferred for long runs because it has less attenuation than either a rigid or an elliptical waveguide. It also has a cut-off frequency limit the same as rectangular or elliptical. One of the great advantages is where dual polarization is required for a given path, such as one polarization for analog and the other digital, two regular waveguide runs are eliminated. Or, in the case of AT&T, one frequency is horizontal and the adjacent channel is vertical. This cross-field approach yields about 30dB of isolation between polarizations. Where both ends of the waveguide have circular-to-rectangular transitions, it is considered a "closed system." An open system is one in which there is only rectangular transition at the feed point, the antenna having no transition. The horn or the cornucopia-style of antenna that AT&T used is an example of an open system.

A circular waveguide operated below the cutoff frequency is used in the older signal generators for attenuation. The Measurements Corp. signal generator used the circular waveguide below the cutoff frequency by incorporating a small loop as the injector, and another loop for pickup that was transported along the waveguide in a linear fashion. The linear distance was calibrated in decibels of attenuation. Attenuation of several orders of magnitude can be obtained using this method. ■

WHEN STABILITY COUNTS



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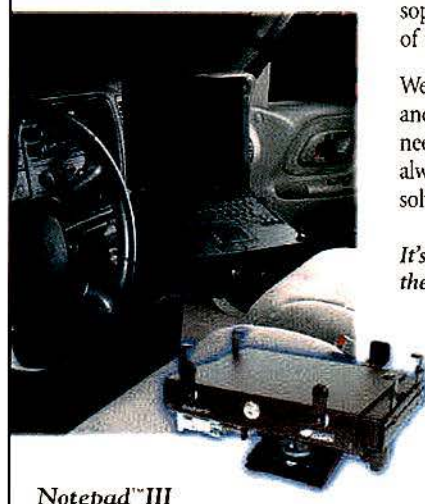

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IWCE 2002 Show Preview

This year the International Wireless Communications Expo will present seminars and programs on topics ranging from the Nextel White Paper to the public safety efforts at the World Trade Center. Below are some events you won't want to miss to stay informed in the radio industry.

❑ **TETRA Seminar**
Tuesday, April 23
1 p.m.–4 p.m.
The North American TETRA Forum will be hosting a seminar on the advantages of adopting TETRA in North America. The seminar will include presentations by manufacturers and users of TETRA. There is no cost to attend the seminar, but preregistration is required. Email your name, company name, job title, address and phone number to *info@tetraforum.org*. The deadline to register is April 2.

❑ **Keynote Address:**
Jay Kitchen,
President of PCIA
Wednesday, April 24
9 a.m.–10 a.m.
As president of the Personal Communications Industry Association, Jay Kitchen is a leader in the wireless communications industry. Kitchen assumed the presidency in 1994, and since then has led PCIA's way to meeting the challenges of an increasingly complicated and competitive telecommunications market. He has developed PCIA's core competencies of providing valuable business solutions, removing barriers to business growth on a global scale, gathering and sharing international and country-specific marketplace intelligence and advocating for public policy on behalf of its members. He has helped launch industries such as PCS and to facilitate the growth of mobile convergence.

❑ **RCA Breakfast Meeting**
Thursday, April 25
7:30 a.m.–9 a.m.
The annual Radio Club Breakfast will be held at the Monte Carlo. It is a chance to network with other club members in a relaxed atmosphere. Reservations are required. Register at the Radio Club of America booth #16055 on Wednesday, April 24.

❑ **IWCE Live!**
Log onto **www.mrtmag.com** and click the Special Reports link to find live news updates from the show floor.

A must-attend session

Don't forget to attend the Nextel White Paper session on Wednesday, April 24 from 3 p.m.–3:45 p.m. Nextel has lofted an idea to relocate and realign the 800MHz band. What does it mean and how can it affect you? This is sure to be an interesting session.

Base station workshops

This series returns to IWCE as a vital part of a comprehensive program for base station operators and technicians, and is designed specifically for their needs. Whether you're a novice or a veteran, IWCE's Base Station Workshops offer solutions you can put to use right away.

Monday, April 22
Telecommunications grounding practices
8:30 a.m.–12:30 p.m.
Grounding is a subtle but exceptionally important issue for the safe, efficient and reliable operation of wireless communications systems.

RF and microwave basics
1:30 p.m.–5:30 p.m.
This course covers a wide variety of basic RF and microwave topics for people who have a basic understanding of electronics and telecommunications and need to know more.

Tuesday, April 23
Basics of mobile radio
8:30 a.m.–12:30 p.m.
Anyone with a basic understanding of electronics and the need to know how wireless communications systems work will benefit from this one-day course.

Civil engineering for telecom professionals
1:30 p.m.–5:30 p.m.
Attendees to this course are introduced to the "tricks of the trade" in dealing with towers and buildings used in the telecommunications industry.

Wednesday, April 24
Implementing mobile data systems
8:30 a.m.–12:30 p.m.
This workshop discusses important issues related to implementing various types of mobile data systems, including the core features of a mobile data system.

Schedule of Events

Monday, April 22, 2002

8 a.m. **Registration (Workshops only)**
8:30 a.m. Base Station Workshops: Telecommunications grounding practices
9 a.m. Radiation Safety/Compliance Workshop (Session runs from 9 a.m.–5 p.m.)
12 p.m. SBT Jam Session, Alexis Park Hotel
1:30 p.m. Base Station Workshops: RF and microwave basics

Tuesday, April 23, 2002

8 a.m. **Registration (Workshops only)**
8:30 a.m Base Station Workshops: Basics of mobile radio
9 a.m. Radiation Safety/Compliance Workshop: Radiation safety and FCC compliance for wireless telecommunications professionals (Session runs from 9 a.m.–12:30 p.m.)
1 p.m. TETRA seminar
1:30 p.m. Base Station Workshops: Civil engineering for telecom professionals

Wednesday, April 24, 2002

8:00 a.m. **Registration opens**
8:30 a.m. Base Station Workshops: Implementing mobile data systems
9 a.m. Keynote address
10 a.m. **Exhibit hall opens**
10:30 a.m. PCIA Workshop: The 21st-century radio dealer
1 p.m. Business & Tech Track—Insuring your business
Regulatory Track—The status of VHF/UHF trunking
Public Safety Track—AGILE
2 p.m. Business & Tech—Advertising and marketing for beginners and old hands
Regulatory—Leasing 700MHz guardbands
Public Safety—NPSTC: Computer-assisted pre-coordination resource and 700MHz database system
3 p.m. Business & Tech—The Telecommunications Development Fund
Regulatory—Nextel's White Paper
Public Safety—OpenSky: Technology update and status
4 p.m. Business & Tech—Leverage: Getting on top in contract negotiations
Regulatory—Interconnection Update: The skirmishes and battles continue
Public Safety—P25: What's out there besides the obvious?

Thursday, April 25, 2002

7:30 a.m. RCA breakfast meeting
8:00 a.m. **Registration opens**
8:00 a.m. Simulcast Forum, Las Vegas Convention Center
9 a.m. Business & Tech—Buying and selling telecommunications assets
Regulatory—Auction dust settlings
Public Safety—The World Trade Center
10 a.m. **Exhibit hall opens**
10 a.m. Business & Tech—The Tower Market
Regulatory—The ULS Tutorial: The last year has seen changes in the ULS and the FCC Web site. Keep up with the changes.
Public Safety—Nextel: Overview of interference issues
11 a.m. Business & Tech—Tower paper
Regulatory—Update of 220MHz–222MHz band use
Public Safety—Nextel Panel Discussion
1 p.m. Business & Tech—Solving RF exposure issues in a cost-effective manner
Regulatory—FCC Open Forum
Public Safety—Project Greenhouse: Technology update and status
2 p.m. Women in Wireless Communications
Business & Tech—Valuing assets: What are your assets worth?
Public Safety—Project MESA: New international high-speed broadband data standardization effort
3 p.m. Business & Tech—LCC: Is it right for you?
Regulatory—Leasing and managing channels
Public Safety—Tower safety
4 p.m. Business & Tech—Mobile data business
Regulatory—AVL in the mix
Public Safety—Telematics: ACN is bridging over to public safety. What's the impact?

Friday, April 26, 2002

8:00 a.m. **Registration opens**
9 a.m. Business & Tech—Employment contracts and non-compete clauses
Regulatory—FCC speed traps: What are the agency's enforcement personnel looking into?
Public Safety—PSWN: Coordination and partnerships, funding, spectrum, standards and technology and security
10 a.m. **Exhibit hall opens**
10 a.m. Business & Tech—Bankruptcy defense: How to protect yourself when your customer goes bankrupt
Regulatory—FCC update: What's new?
Public Safety—NYSTEC: WTC lessons learned and disaster recovery

IWCE 2002 Exhibitors

The following preview information was supplied by the exhibitors. Information for listings and booth numbers is accurate as of press time and is subject to change. See www.iwceexpo.com for updates.

AC Data Systems **Booth 10083**
Existing products
Surge suppression products for ac,dc, data, telco and T1 lines; integrated load center and transfer switch products.
New products
AC2070 and AC4100 TVSS units for small to medium ac services; MOV and SAD modules.

AC-DC Industries **Booth 10107**
Existing products
MZL-10F delay timer (15, 30, 45 and 60 minutes); MZL-10S delay timer (30, 60, 90 and 120 minutes); MZL-10SS delay timer (two, four, six and eight hours); MZL-18 delay timer.

ACE Technology **Booth 12106**
Existing products
AMPS, PCS, GSM, ISM, PCS, GPS antennas and RF components.

Adtran **Booth 14146**
Existing products
Unlicensed spread-spectrum digital microwave radio systems; Tracer dual T1 and dual E1 capacity radios at 2.4GHz and 5.8GHz; channel bank and multiplex equipment for carrier and enterprise applications; Tracer 10 Base T radio; protection switching for Tracer equipment; Nx64, user-selectable 1–24 DSO data radio with v.35 interface.

Advance Label & Tag **Booth 13100**
Existing products
Custom nameplates for radios, pagers, cellphones and other wireless equipment; warranty and tamper-proof labels; screen-printed metal, vinyl or polyester labels; indigo digital or flexographic printed vinyl or polyester labels.

Advanced Charger Technology **Booth 11081**

AdvanceTec Industries **Booth 10014**
Existing products
Negative pulse reconditioning and chargers for cellphones and two-way radios; pulse analyzers for NiCd and NiMH batteries; portable hands-free units for cellphones.

AEA Wireless **Booth 10078**
Existing products
Antenna analyzers covering 100kHz to 999MHz; VIA analyzer 100kHz–54MHz; VIA-Bravo 1MHz–150MHz; 140–525 analyzer; Cell Mate 806MHz–960MHz.
New products
VIA Bravo 5014-5000; 1MHz–150MHz complex impedance analyzer based on a PDA.

Aerocomm **Booth 13120**

AF CommSupply **Booth 10082**
Existing products
Microwave and conventional antenna systems.

Alexander Technologies **Booth 13027**
Existing products
Two-way radio batteries; battery charger; analyzers; two-way mobile mount chargers.
New products
Lexstar premium batteries.

Alltec Lightning & Grounding **Booth 14137**
Existing products
TS-500 series TerraStat dissipators; TS-400 TerraStat dissipators; TVSS products; TerraBar Samples; GroundBars.
New products
TS-510 series TerraStat Dissipators.

American Mobile Telecommunications Association/International Wireless Telecommunications Association **Booth 15098**

Amerizon Wireless Wholesale Communications Distribution **Booth 12095**

Amplifier Research **Booth 14059**
Existing products
High-power, broadband RF amplifiers; related test accessories.

AMREL Systems **Booth 12111**
Existing products
Rocky Unlimited; Rocky mobile.
New products
Rocky Matrix.

Anchor Graphics **Booth 17083**
Existing products
Communications labels; bar codes; ID labels; all types of custom labels; tamper-evident labels.

Andrew **Booth 13075**
Existing products
Coaxial cable; cable prep tools for connector attachments; step-tuned connectors for elliptical waveguides; accessories; EXT towers for land mobile installations.

Anritsu **Booth 15095**
New products
MS2711B hand-held spectrum analyzer; Site Master C-series cable and antenna analyzer.

Antcom **Booth 15128**

Antenex **Booth 10010**
Existing products
Mobile, base and portable antennas; patented Phantom antennas and accessories.

Antenna Plus **Booth 14119**
Existing products
Low-profile antennas.

Antenna Specialists **Booth 14027**
Existing products
Mosaic land mobile radio antennas; Tele-locator dual-system GPS antennas; dual-band On-Glass rooftop and magnet mount antennas; 800MHz On-Glass magnet and roof mount antennas; EAC-50 in-building repeater kits for cellular, 800MHz trunking and PCS; subscriber fixed station planar, yagi and omnidirectional antennas.
New products
K721 GPS Mosaic LMR/GPS trunk lid mount; K1860PGPS Tele-locator LMR/GPS thru-hole mount; ASPDM1947/CP TalkAround cellular/PCS mini-magnet with Star-Tac jumper cable.

APCO International **Booth 17104**
Existing products
APCO International AFC, a spectrum-management leader, is FCC-certified to provide frequency coordination and telecommunications services to your community; 68th Annual APCO Conference & Exposition.

A & R Telecom **Booth 14129**
Existing products
Seismic relay racks; ladder cabling systems; batteries; battery tray; dc power plants; cable assemblies.

Astratec Electronics **Booth 12141**

Astron Wireless Technologies **Booth 16111**
Existing products
Flextron portable antennas; frequency flexible yagi antennas; Lo Pac low-profile antennas; ISM band omni-directional and directional antennas.

New products
PCNLP24 low-profile button antenna.

Astron **Booth 10063**

Atlantic Scientific **Booth 12135**
Existing products
Zone Master plus series; Zone Master series; site cabinets; Zone Barrier series; tower light protectors.
New products
Rackshield series.

Atlantic Solar Products **Booth 15125**

Avtec **Booth 11068**
Existing products
DSPatch family of dispatcher console systems.
New products
DSPatch base station controller.

A.W. Enterprises **Booth 17037**
Existing products
Carrying cases for two-way radios; Nextel phones and pagers. Cases fit Motorola, Kenwood, Johnson, Vertex, ICOM, TEKK, King, Relm and Ritron radios.

Bard Manufacturing **Booth 16146**

BEE Electronics **Booth 10017**
Existing products
Leather and nylon carrying cases for all brands of portable communications devices including LMR and FRS radios, cellular and PCS telephones and pagers.

Berkeley Varitronics Systems **Booth 12078**

Bluewave Antenna Systems **Booth 14106**

Bro-Comm **Booth 15127**

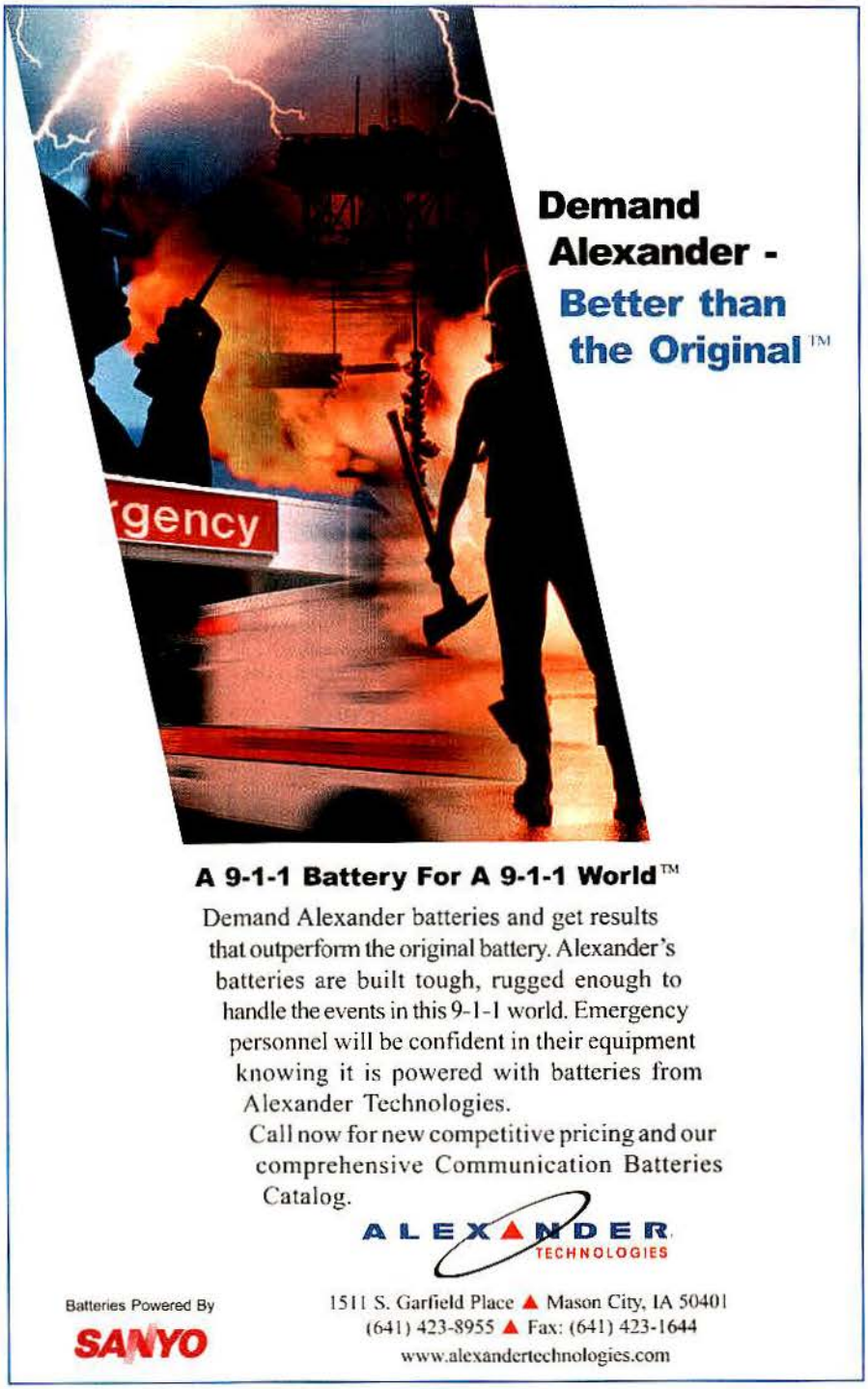
Cadex Electronics **Booth 15049**
Existing products
Cadex 7200 battery analyzer; Cadex 7400 battery analyzer; Cadex Batteryshop version 4-0; Cadex universal conditioning chargers.
New products
Cadex 7400 battery analyzer with quick learn.

Carlson Wireless Technologies **Booth 13141**
Existing products
T-PE Trailblazer phone line extender; T-LL Trailblazer leased line emulator; T-FT Trailblazer fractional T1-E1; T-EB Trailblazer Ethernet bridge.
New products
I-WLL Globalconnect.

Catalyst Communications Technologies **Booth 12147**
Existing products
Voice-over-IP products using PCs to dispatch over wide-area computer networks; Network Access Radio and IP Radio.
New products
IP Fleet that supports LTR trunking and Kenwood FleetSync; IP Base that operate radios from multiple vendors using standard EIA tones or 5V binary signaling to change channels and initiate transmit for radio control.

Cellport Systems **Booth 17124**

Cellular Specialities **Booth 14130**



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Centurion Wireless Technologies **Booth 14049**

CeoTronics **Booth 11061**
Existing products
Radio headsets; two-way radio headset; lightweight headsets; security and surveillance headsets; tactical headsets; EMS headsets; headsets for high noise, respirator and HAZMAT suits.
New products
Digital full-duplex radio headset; 2GHz–4GHz license free multichannel, multi-user configurations with headset.

CES Wireless Technologies **Booth 15075**
Existing products
Fleet Management series; mobile information AVL and messaging devices; single, multiple and Internet accessible software systems.
New products
GPS-230 GPS/GSM vehicle location device; Multi-Trak Internet workstation; Flash Box external data logging unit; Leopard OEM mobile data product family.

ChargeGuard **Booth 17027**
Existing products
Chargeguard CG12D; Shopware v4.0.
New products
Shopware with Quick Books Billing.

Childs Antennas **Booth 15094**
Existing products
Two-way radio antennas.
New products
Mobile radio antennas and mounts; portable radio antennas; base station antennas.

Cimarron Technologies **Booth 17039**
Existing products
MDC-1200; GE-STAR encoders; C Plus decoders for MDC-1200, GE-STAR and Fleetsync; Skymark and Vehicle tracker; two-way radio and CDPD.
New products
C Plus I, II and III encoders/decoders for Fleetsync, GE-STAR and MDC-1200.

Citel **Booth 14142**
Existing products
Surge suppressors for ac power, telephone, RF coaxial, telephone and data lines such as Citel Surge Guard and Surge Purge.
New products
UL 1449 SurgeGuard modular ac surge protectors.

CML Emergency Services **Booth 17114**

CommScope **Booth 10026**

Commtech Wireless **Booth 17119**

Compac Development **Booth 15053**

Computer Resources **Booth 14071**
Existing products
Service and sales management; mobile radio billing; Harmony provisioning and billing; rental management; pager billing; all related accounting; Motorola conventional trunking automation.
New products
Payroll 2002; MRB 2002.

ComSpace **Booth 15103**
Existing products
Digital LTR radio and base station designed to allow one-channel-at-a-time migration, using existing analog infrastructure. At 25kHz, DC/MA technology (digital channel multicarrier architecture) transforms one analog channel to eight digital channels and provides a coverage area equivalent to a standard FM footprint.

Comtelco Industries **Booth 10034**
Existing products
Base-station antennas; mobile antennas; yagi antennas; low-profile mobile antennas; panel antennas.

Comtronics **Booth 10098**

Connect Systems **Booth 14120**
Existing products
Repeater tone panels; LTR system controllers; interconnects (simplex and full duplex); ANI decoders; rural phone system controllers.

CPI Communications **Booth 13069**
Existing products
Dc remotes; dc panels; local extensions; tone remotes; tone panels; multichannel products; term panels; dc-to-tone converter; satellite products.

CPR Technology **Booth 12131**
Existing products
Nextel accessory items including headsets, batteries and cases.
New products
Remote speaker microphone for Nextel.

Crescend Technologies **Booth 12059**

CSI Shelter Technologies **Booth 13139**

Cushcraft **Booth 16018**

CVDS **Booth 11109**
Existing products
Comlog digital voice recorders.

Daniels Electronics **Booth 11092**
Existing products
MT-3 modular radio repeaters and base stations, 29MHz–960MHz.
New products
MT-3 VHF paging systems; MT-3 20W, 118MHz–139MHz AM radio system; MT-4 P25 digital radio systems.

Dantherm HMS **Booth 17100**
Existing products
Escalade wall mount HVAC; Classic panel mount HVAC; Pinnacle heat exchanger.

Dataradio **Booth 13063**
Existing products
Gemini; MobilPac.
New products
Gemini 32kbps.

Datron World Communications **Booth 10101**
Existing products
Guardian Project 25 portable and mobile radios; accessory equipment.

David Clark **Booth 15056**
Existing products
Headset with PTT adapter cords for mobile and portable radios; voice-activated headsets for portable radios; headset intercom systems with two-way radio interface.
New products
Vox headset with vented eardome/HAZMAT operations; radio adapters with body-type PTT/hands free applications; Marine Intercom system with two-way radio interface.

David Levy **Booth 10035**
Existing products
Speaker and earphone microphones; battery switches; switch panels; high-current distribution blocks; battery terminals and adapters; barrier strips; fuses and fuse holders; circuit breakers; installation hardware; P.A. amps; P.A. speakers; tools and service.
New products
Optima batteries; battery separators and isolators; safety signal mirrors; video cameras; electro luminescent lighting.

dBSpectra **Booth 13124**
Existing products
DBS118AA voltage follower; DBS106AA five-channel TX/RX test unit for 806MHz–869MHz.
New products
DBS113AA eight-channel hybrid combiner with integrated receiver multicoupler for simplexed radio connections; DBS125AA four-channel 806MHz–869MHz hybrid combiner 30W CW; DBS129AA dual duplexed 1,900MHz combiner; DBSCBC VHF, UHF, cellular and PCS crossband coupler.

Decibel Products **Booth 14147**
Existing products
DBE2802 tower-mounted amplifiers;

DB Omni antennas; DB7400 RX multicoupler.
New products
DB8815A dB alarm dialer; DB4368 low-loss TX combiner.

Delta Electronics Mfg. **Booth 17069**

Digital Dispatch Systems **Booth 14135**

Digital Paging **Booth 12088**
Existing products
Apollo 202; Apollo 301; Apollo 500R; Apollo 812; Apollo 777; Apollo FRS two-way radio.
New products
Apollo 801; Apollo T-plus; Apollo Signature 333; Apollo 924.

Digital Voice Systems **Booth 13114**

Digital Wireless **Booth 16027**

Dispatch Products **Booth 13107**
Existing products
Dispatch work station.

Drivertech **Booth 16101**
Existing products
Truck-PC DT-2000 featuring AVL and CAD.

DuPont Building **Booth 16119**
Existing products
Environmentally sound, non-corrosive fiberglass equipment; auxiliary power systems; shelters that provide protection of equipment—suitable to any environment.

DuraComm **Booth 12084**
Existing products
Desktop power supplies; rack-mount power supplies; battery backup modules; tone and voice pagers; OEM power supplies.

DX Radio Systems **Booth 16035**
Existing products
Repeaters and base stations; trunking systems; paging transmitters; radio telephone links.

Dyplex Communications **Booth 17082**
Existing products

Phonak-inductive loop; Phonito; MicroEar.
New products
Phonak-Intra inductive receiver.

EADS Telecom **Booth 13113**

Eagle-Picher **Booth 10125**

Eartec/ PortaPhone **Booth 13102**
Existing products
Heavy-duty double and single earmuff accessories for portable radios.

EF Johnson **Booth 11001**
Existing products
SmartNet/SmartZone-compatible mobiles and portables; fixed land mobile radio transceivers; mobile and portable radios for use on APCO 16 and 25 trunked and conventional analog and digital systems and LTR-Net trunking systems.

Electro-Comm Distributing **Booth 10060**
Existing products

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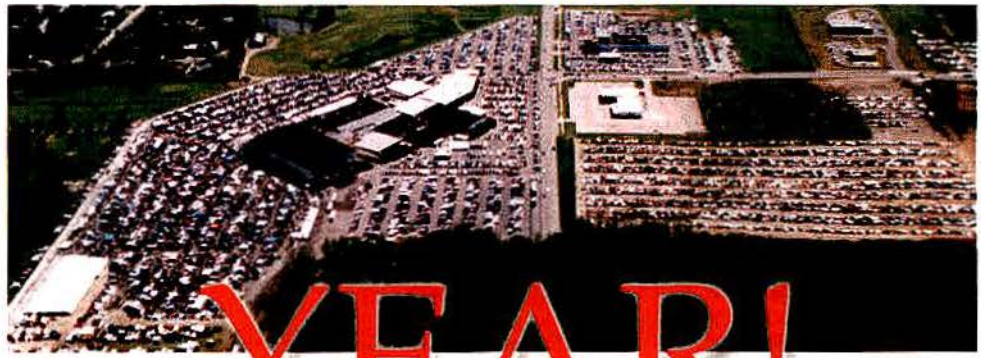

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Electronic Systems Technology **Booth 16115**

Electronics Representatives Association **Booth 1112**

ELISRA/ Parker RF Technologies **Booth 14141**

Electronic Metrology Laboratory **Booth 16022**

EMR **Booth 12063**
Existing products
Filter-ferrite and hybrid-ferrite combiners; receiver and tower-top multicouplers; bi-uni directional systems; mobile/base stations; small format duplexers; isolators; I.M. panels; bandpass/passnotch cavities; line taps; power amplifiers.
New products
SYS-20 combining systems.

Enviro Buildings **Booth 11106**

EPCOM **Booth 17063**
Existing products
ICF3GS/ICF4GS-90 multimode two-way radios; TKR750/TKR850 rack mount commercial repeaters; ICOM repeater maker kits-ITS-10; Syscom VHF/UHF commercial amateur duplexers.
New products
Trailblazer spread-spectrum telephone line transmitter; Syscom ANV 365TX/366RX video/audio transmitter; SNS 100 Samsung video transmitter; Kendoo XXRP rapid chargers.

Eventide **Booth 10068**
Existing products
Digital voice logging recorders and instant recall recorders.

Exacom **Booth 15111**

Fanon Courier **Booth 12064**

Federal Communications Commission **Booth 14132**
Existing products
Universal licensing system; automated auctions software.

Federal Signal **Booth 11128**
Existing products
Federal Commander digital two-way monitoring system; Federal Controller two-way informer.
New products
UltraVoice.

Fibox Enclosures **Booth 12125**
Existing products
Non-metallic NEMA 4× enclosures from 2×2×2 up to 24×16×10—more than 500 off the shelf sizes.
New products
MNX series, 5×3×1.5 up to 10×7×7, special recessed covers for membrane key pads molded in; CAB series, 12×8×7 to as big as 24×16×10, hinged enclosures with front plate options.

Fibrebond **Booth 17074**
Existing products
Concrete equipment shelters; equipment installation services; guyed and self-supported towers.

1st Contact Technologies **Booth 17115**
Existing products
FarVillage and FarEdge wireless ISP franchise opportunities.

Fleetstat AVL/ Cook's Communications **Booth 11075**
Existing products
Fleetstat AVL vehicle tracking system; Fleetstat AVL GPS mapping software.
New products
Fleetstat AVL 3.0 network compatible software; Fleetstat AVL 3.0 with updated mapping and reporting options.

Fred A. Nudd **Booth 13110**
Existing products
Self-supporting towers; guyed towers; monopoles; mounting hardware.
New products
Non-penetrating roof mount.

Futurecom Systems Group **Booth 16095**
Existing products
Sitexcom, channel selective RF repeaters; Chanexcom multiband line amplifiers; Mobexcom vehicular repeaters.

Fylde Micro Systems **Booth 11115**

GAI-Tronics **Booth 10095**
Existing products
Tone remote desk sets; dc remote desk sets; Kenwood-compatible trunking desk sets; local controllers; telephone interfaces; repeater controllers; accessory dispatch microphone.
New products
ICP9000 radio dispatch console capable of controlling as many as 12 base stations.

Gamber-Johnson **Booth 16014**
Existing products
In-dash mounts; pedestal mounts; universal and dedicated bases; radio console boxes; mobile docking stations; universal cradles.
New products
EPIC console boxes; Motorola NW520 mounting solution.

General Dynamics/Decision Systems **Booth 17088**

The Genesis Group **Booth 17097**
Existing products
GenSZAI/NetVista-SmartZone and Dimetra Management solutions; GenWatchXL-system management for SmartNet; Genesis Trio-customer management and billing software for Harmony.
New products
AffVista-radio affiliation monitoring software; Genesis Trio-customer management and billing software for SmartZone and Dimetra; Genesis Trio Service Bureau.

Glentel **Booth 15140**

Granger Telecom **Booth 10074**

Harger Lightning & Grounding **Booth 10110**
Existing products
Lightning protection; grounding equipment; exothermic connectors; surge suppressors; communications grounding equipment; enhanced grounding rods; engineering services.
New products
Tower stand-offs; CGKB coax kits; RFPG series RF surge protectors; MCT & MCT81/0 compression tools.

Hark Tower Systems **Booth 16021**
Existing products
Tower site monitoring products; TSM2000, ULM-130, NOC and Web NOC software.
New products
OC-100 and OC-200 telephone line isolator.

Harris-Intraplex **Booth 17120**
Existing products
Intraplex Crossconnect system and server; Intraplex access server.

Havis-Shields Equipment **Booth 11102**
Existing products
Consolidator vehicle consoles; computer mounts (TCB patent Des. 429, 251).
New products
Dash mount for Motorola MW-520 mobile workstation (C-3052-4); Impala slide-out radio tray; 24" long consoles with storage compartment.

Heartland Capital Leasing **Booth 17110**

Holaday Industries **Booth 12115**

Honeywell Obstruction Lighting **Booth 11131**
Existing products
FAA dual lighting system; incandescent controls.

Hutech **Booth 10085**

Hutton Communications **Booth 15001**
Existing products
Site infrastructure products; radio communications equipment; wireless telephone accessories; power systems products; test and shop equipment.

ICOM America **Booth 11048**
Existing products
Land mobile transceivers and application-specific communications equipment including portables, mobiles, repeaters, Passport-ready trunking subscriber units, wideband scanners and receivers.

ICT **Booth 11099**
Existing products
Twelve-volt and 24V power supplies; base station covers; N+1 redundant power systems; microprocessor controlled battery chargers; isolated and non-isolated dc converters; noise filters; surge protectors.
New products
Dual/tri-rack mount power supplies; 48V power supplies; 24V microprocessor controlled battery chargers; 24V wide range isolated converters.

IDA **Booth 15021**
Existing products
Trakit AVL system; Trakit Nationwide; RLC trunking controllers; 24-series remotes and panels; Net-Link; Easy-Link and Kencall.
New products
Trakit Nationwide; 24-30 Tone remote.

IFR Americas **Booth 11039**
Existing products
Solar modules; controllers.
New products
Sunpak 3P 40V/54V/12V.

Industrial Telecommunications Assn **Booth 16083**

International Municipal Signal Association **Booth 14125**
Existing products
Public safety frequency coordination services; dispatcher certification programs; association membership and Washington representation.
New products
800MHz frequency coordination services.

IP MobileNet **Booth 10086**

ISR FleeTrac **Booth 11111**

iTECH **Booth 15118**
Existing products
Battery charger, analyzers, conditioners: iQten, iQfive, iQpac.

JBRO Batteries **Booth 10000**

John Mitchell Company **Booth 17035**
Existing products
Radiopac VI software: SMRS billing, point of sale, service shop, accounts receivable.

Jotto Desk **Booth 16118**
Existing products
No hole mounts; contour consoles.
New products
Console side mount.

JPS Communications **Booth 10092**
Existing products
NXU-2 network extension unit; TRP-1000 with ACU-1000 (intelligent interconnect system); SNV-12 signal-to-noise voter.

Kathrein Scala Division **Booth 14062**
Existing products
Antennas for cellular and PCS; base antennas for land mobile.

Kaval Wireless Technologies **Booth 16807**
Existing products
Linknet convergence platform; In-Hancer series BDA400; UHF bi-directional amplifier; In-Hancer series BDA900; trunking bi-directional amplifier; Tap-in signal distribution tap.
New products
LinkNet satellite unit LNKFIB designed to distribute multiple wireless signals and protocols over a single distributed antenna network; LinkNet management systems offering customers 24-hour visibility and control of all active equipment and systems.

Kenwood Communications **Booth 12001**
Existing products
Public safety mobiles and portables; complete line of trunking mobiles and portables; repeaters.

KR NIDA Communications **Booth 10064**

Kullman Industries **Booth 14108**
Existing products
MTSO buildings; modular equipment; switch stations; COWs.

Kyocera Solar **Booth 10084**
Existing products
Solar modules; controllers.
New products
Sunpak 5P 40V/54V/12V.

Kyosey **Booth 17116**

L&E Mobile Computers and Mounts **Booth 15116**

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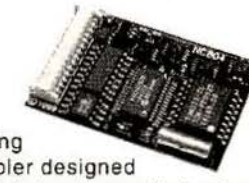

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Lease Acceptance **Booth 10089**
Existing products
Finance/equipment lease programs.

Lease Corporation of America **Booth 13165**
Existing products
Leasing information.

Lind Electronics **Booth 17112**
Existing products
Dc power adapters for mobile computing devices.
New products
Dc power adapter with panel mount extrusion.

Link Communications **Booth 15117**
Existing products
RLC series repeater controllers and interfaces.
New products
RLC-LTR trunking controller.

Lone Peak Designs **Booth 11065**

M/A-COM Wireless Systems **Booth 12033**

Marvair **Booth 15124**
Existing products
Air conditioners and Crispaire environmental control units for cooling telecommunications shelters and cabinets.

Maxrad **Booth 10039**
Existing products
Antenna products and accessories; in-building voice, data and broadband wireless communications.
New products
MLPV800HD vertical antenna for 800MHz–900MHz; BMOY series black optimized yagi antenna; new models for the GPS antenna line for telematics.

MCM Technology **Booth 13135**
Existing products
Information technology systems for mobile communications companies including real-time service management, inventory control paging, mobile radio billing, purchasing and full accounting.

Mentor Engineering **Booth 16052**
Existing products
Mobile data computer version 3.2; Xgate middleware.
New products
Windows CE tablet-style PC called Stryder.

Merry Electronics USA **Booth 16071**
Existing products
DMC series mics; HSC series hand sets; DSH series speakers, DEC series mic elements; DTR series transducers; EMC series handsets.

Microwave Data Systems **Booth 16048**
Existing products
MDS LEDR 900S; MDS LEDR 400S; MDS LEDR 1400S; MDS LEDR 400F; MDS LEDR 1400F.

Midian Electronics **Booth 14066**
Existing products
DDU series decoders; CAD series decoders; Motorola MDC-1200 compatible decoders.
New products
STI series interconnects; PDE-1 paging and dialing encoder; Plug-in scramblers for Vertex radios; VPU-15 series inversion scramblers.

Midland Radio **Booth 17020**
Existing products
Base stations; mobile radios; portable radios.
New products
VoIP for base stations; VHF/UHF portables.

***Mobile Radio Technology* magazine** **Booth 16055**
Existing products
Mobile Radio Technology is recognized as the leading source of technology-focused industry guidance. Readers include mobile radio dealers and service shops, large-volume end users at public safety, government, transportation, business and industrial agencies, as well as paging and SMR service providers, and manufacturers and their reps and distributors. The editorial stresses the latest in equipment and applications, business developments, legal and regulatory matters. Visit our booth to pick up a copy, and sign up for your free subscription.

Motorola **Booth 12083**

Mountain Union Telecom **Booth 11104**

MTS Wireless Components **Booth 11093**
Existing products
Antenna towers; support structures; cables and accessories; racks; assorted hardware; wireless components; infrastructure for cellular and PCS; infrastructure for paging; lightning protection; cell site microwave systems and components; mounts and mounting equipment; tower lights.

Multiplier Industries **Booth 13095**
Existing products
Replacement batteries for two-way radios and cellphones; IDENS.

NARDA Safety Test Solutions **Booth 10080**
Existing products
RF survey equipment.

National Distribution Center **Booth 16125**
Existing products
See Web site at **www.ndcsales.com**.

National Products **Booth 13131**

Nearson **Booth 14118**

NERA Telecommunications **Booth 11124**

New-Tronics Antenna **Booth 12060**

NEWMAR **Booth 15019**
Existing products
Dc power systems; rackmount power modules; hot swap power shelves; dc-to-dc converters; low-voltage disconnects; meter panels; integrated power systems with built-in back-up batteries; complete power rack assemblies with all necessary power accessories, custom configured to site requirements.

NexTek **Booth 13134**

Nextel Analog Services **Booth 16125**

NK Cables USA **Booth 11107**
Existing products
50Ω copper corrugated RF cables for wireless applications; jumper cables; connectors; accessories.
New products
RFE-7/8" flexible feeder 7/8 cable.

Northern Technologies **Booth 17031**
Existing products
Quarterwave RF protection series; rackmount frame ac protection series; DMK series; uninterruptible power supplies series.
New products
Environmentally controlled cabinet; power distribution cabinet with automatic transfer switch.

Numerex **Booth 16141**

OmniLocation Technologies **Booth 10099**

OptoElectronics **Booth 13104**
Existing products
Frequency counters; Nearfield receivers; tone decoders; RF detectors; digital frequency counters; bandpass filters; hand-held counter/decoder.
New products
Scan Pal trunked radio interface.

Orbacom Systems **Booth 14063**
Existing products
TDM series communications consoles; series 9 dispatch furniture; Genesis CAD.
New products
Mobile CAD; E9-1-1; RMS.

Ormandy Software **Booth 14111**
Existing products
Integrated software that serves accounting, customer care, service, usage/rating and other needs of customers in two-way, paging and cellular industries

Otto Engineering **Booth 10054**

Peltor Communications **Booth 15057**
Existing products
Noise-attenuating headsets; emergency vehicle systems; communications headsets.

Penta **Booth 11098**
Existing products
Integrated radio and telephone control systems; touch-screen dispatch consoles; remote base station controller; telephone interconnects; remote radio controllers.

PHI Enterprises **Booth 15143**

Polar Electronic Industries **Booth 10116**
Existing products
Base station antennas: grid parabolic, omnidirectional, directional; mobile antennas: roof-mounted, ground-independent, disguise types; RF filtering equipment: cavity resonators, duplexers, multicouplers; accessories: power dividers, damps, attenuators, dummy loads.
New products
Stainless steel yagi model 965; portable grid parabola model GM10-23; surge arrester model PLA.

PolyPhaser **Booth 12074**

Power Conversion Products **Booth 16107**

Power Products **Booth 13116**
Existing products
Rechargeable batteries for two-way radios and accessories for cellphones; NiMH versions of two-way radio batteries.

Precision Test Systems **Booth 13126**

Primus Electronics **Booth 17087**
Existing products
Cable; connectors; mobile and base station antennas; lightning protection; tower products and accessories; power supplies; amplifiers;batteries; cable assemblies.

Project 25 Technology Interest Group **Booth 10115**

Pryme Radio Products **Booth 17079**
Existing products
SPM-100 series mics; SPM-300E series mics; SPM-900 series mics.
New products
SPM-400A series mics; SPM-800 mics; SPM-1000 series surveillance kits; SPM-1400 series mics; SPM-1100 series mics.

PTMW **Booth 13119**

Public Safety Wireless Network **Booth 16075**

PWRA **Booth 14131**

Pyramid Communications **Booth 14075**
Existing products
2017 Merlin AVL fleet tracker; Street Smarts mapping software; SVR-200 series vehicular repeaters; 2012 mobile data terminals with AVL option.
New products
9300-03-2010 mapping software for Merlin AVL fleet tracker; APF-1604 and BRF-1601 filters allowing VHF in-band vehicular repeating.

Racing Electronics **Booth 11086**
Existing products
Headsets; custom wire products; complete race communications systems.

Radiall /Larsen Antenna Technologies **Booth 15015**
Existing products
Wire omni, yagi, sectoral wall, flexible blade and planar array base stations; mobile GPS; dipole line.
New products
Solid parabolic dish, grid parabolic dish, shrouded yagi, fixed sectoral and field adjustable sectoral base stations; gas discharge and quarterwave lightning protectors; low-loss cable; mobile GPS.

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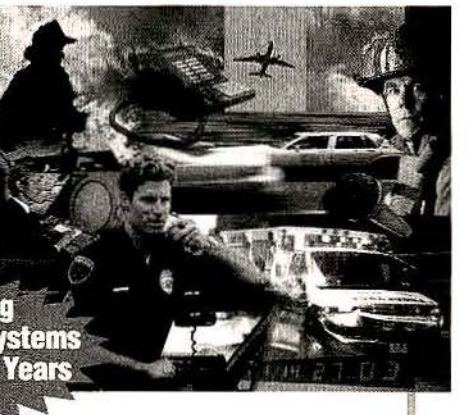

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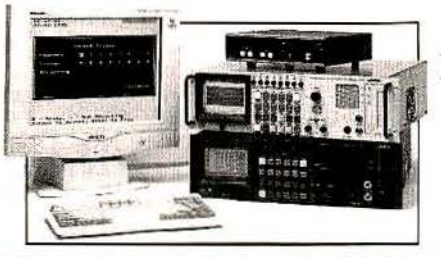

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Radio Club of America **Booth16055**

Radio Frequency Systems **Booth 15034**

***Radio Resource* magazine** **Booth 10020**
Existing products
RadioResource magazine; "Public Safety Report"; *RadioResource International.*

RadioSoft **Booth 16121**
Existing products
ComStudy 2.2; Frequency Finder; Radio Forms; Data Finder.

RadioTrac **Booth 12142**
Existing products
On-Demand tracking and emergency location system.
New products
Portable system for use with hand-held radios.

Raine **Booth 13112**
Existing products
Heavy-duty nylon two-way radio cases, cell phone cases; other pouches for police, public safety and military applications.
New products
012R EMT/paramedic radio/gear case.

RELM Wireless **Booth 13049**
Existing products
BK G-series radio; Uniden PRC networking systems; repeater and base stations.
New products
RELM RPV516; RELM RPV532; EarthLoc trucking systems.

***RF Design* magazine** **Booth 16055**

RF Imaging and Communications **Booth 11085**
Existing products
Used radio communications service and general test equipment from HP, IFR, Motorola, Marconi, Stabilock, Cushman, Wavetek; cellular test equipment; PCS test equipment.

RF Connectors **Booth 14095**
Existing products
3.5mm precision adapters (RF-35M-35F and RF35M-35F-1500); new deluxe crimp kit (RFA-4009); MC card connectors (RMC-6010-B); BNC bulkhead jack (RFB-1116-1-03).
New products
1.0/2.3 connectors (RF 123-7300-1) right- angle bulkhead mount jacks; FCC compliant connectors and cable assemblies (RP1006-31 and RP1216-1); semi-rigid connectors and cable assemblies (RFN-1005-15R1 and RSA-3510-1-14); low loss connectors (RFD-1604-2L2 and RFD-1631-2L2).

RF Industries/ Neulink Division **Booth 14097**
Existing products
VHF and UHF radio modems; spread-spectrum 2.4GHz; crystal control link radios; SCADA modules.

RF Technology **Booth 12107**
Existing products
Base stations; repeaters; links-associated equipment; solid-state antenna switches; power supplies.

Ritron **Booth 15027**
Existing products
Quick Talk transmitters; Patriot repeater/exciter; Patriot portables and mobiles; Jobcom two-way radios.
New products
Jobcom JMX 4-series hand-helds; Patriot SST4-series hand-helds; Outpost XT.

Royal Telecom Structures **Booth 15147**
Existing products
Royaltel shelters.

Radiofrequency Safety International **Booth 12143**
Existing products
RF compliance services; customer safety programs; public and custom RF training; hazard assessments and reports; MPE evaluations; RF hazard signs; personal protection equipment.
New products
Site Compliance Plus.

RTI/Securex **Booth 15131**

RUF*NEK Building Systems **Booth 11069**

Sabre Communications **Booth 12110**
Existing products
Guyed and self-supporting towers, monopoles and HF antennas. Tower structural analysis, turnkey construction, tower inspection and project management.

Samlex America **Booth 10048**
Existing products
SEC series regulated dc power supply; RPS series linear dc power supply; SEC series switching dc power supply; PSE series ac/dc inverters.
New products
PST series Pure sinewave inverters; SEC series automatic lead/acid battery chargers; SEC series modular dc power supply with battery charger; SP series industrial power supplies.

Satel Radio Data USA **Booth 11114**
Existing products
Satelline 1W 3ASD radio modems with digital display.
New products
Satelline 10W 3AS Epic with digital display and diversity reception with two antennas.

Savox Communications **Booth 10114**

SCA **Booth 16116**
Existing products
VHF, UHF tone and voice pagers; VHF low-tone and voice pager.

Schott Applied Power **Booth 10023**

Schwaninger & Associates, D.C. **Booth 12101**
Existing products
Legal services to small-to-medium sized telecommunications companies throughout the United States; brokerage services for all telecommunications assets including SMR channels, paging systems and towers.

Scientific Dimensions **Booth 12080**
Existing products
SDI 9900 mobile workstation; SDI MD8006 pedestal mount; SDI 1050 slide mount; SDI 1508 Goosnek; SDI 7278 universal computer cradle.
New products
SDI 7239 seat belt mount; SDI 7510 full console mount; SDI 7520 compact console mount.

Sentor Monitoring Systems **Booth 17105**

Setcom **Booth 13138**
Existing products
Portable and mobile headsets; portable and mobile helmet kits; vehicular/intercom radio mixers; police motorcycle comkits; police bicycle comkits.

Shelter One **Booth 12130**

Shulman, Rogers, Gandal, Pordy & Ecker P.A. **Booth 14133**

Shure Communications **Booth 10004**
Existing products
System mics; gooseneck mics.

Shure **Booth 16124**

Signal Intelligence **Booth 10087**

Simulcast Solutions **Booth 13147**
Existing products
Spectracom Master oscillators; convex audio delay; Dalman Cosmos 4 automatic audio delay; Intraplex synchrocast automatic audio delay; JPS SNV-12 voter comparator.

Sinclair Technologies Booth 12075

Existing products

Power monitors; Excaliber mobile antenna; mobile duplexer; multicouplers; panel antennas; yagi antennas; transmitter combiners.

New products

65° polarization diversity panel antenna; two-way, four-way and eight-way power divider; omni dual-band indoor antenna; 90° dual-band indoor antenna; 180° dual band indoor antenna.

***Site Management & Technology* magazine** Booth 16055

SiteSafe Booth 15096

Existing products

RF engineering; regulatory services, RF health and safety and frequency coordination; system planning; GIS; drive testing; site compliance studies; RFCAD 2.4 propagation prediction software.

Slattery Software Booth 16130

SmartComm USA/ Geiger Comm Booth 12119

SmarTrunk Systems Booth 10011

Existing products

Encryption devices; logic boards.

SoftWright Booth 10018

Existing products

Terrain Analysis Package.

Solunet Booth 15126

Southwest PV Systems Booth 12140

Existing products

Solar modules; system components that include regulators, batteries, battery enclosures and mounting hardware.

SpaceCom Booth 17117

Existing products

High-speed Internet protocol-based data services delivered via a two-way satellite connection; streaming audio and video; telecommunications network backup; disaster recovery and quick-connect.

Spinner North America Booth 11143

Existing products

Connectors for corrugated cable; jumper cables; lightning protectors; assembly tools; calibration kits; power dividers; couplers; attenuators; terminators.

Stancil Booth 10106

Existing products

Digital voice recorder and logger.

STI-CO Industries Booth 17068

Survey Technologies Booth 13109

Existing products

Field Test 4 drive-test signal measurement and coverage analysis software; STI-9400 drive-test signal measurement and coverage analysis system; STI-9450 drive test signal measurement and coverage analysis kit.

New products

Opt. 81 indoor measurement software.

Talley Communications Booth 15063

Existing products

Wireless communications infrastructure; mobile products.

New products

Powerlink power systems.

TCC Industries Booth 11089

Existing products

Ac/dc power supplies; coaxial connectors N, TNC, mini UHF, BNC, UHF, SMA, SMB, EME, reverse polarity and reverse thread connectors; 7/16 DIN; adapter; tools; custom connectors.

New products

Power supplies; coaxial connectors.

TEKK Booth 10038

Existing products

TEKK NT series hand-helds; Remington FRS/GMRS hand-helds; data telemetry radios; paging systems; full line of headsets; speaker and microphones; rapid rate chargers.

New products

TEKK UHF/VHF mobile radios.

Telecom Business Booth 16126

Telepoint Booth 12136

Existing products

Digital wireless delivery system; SR-20/SR-64 point-to-point and multipoint radio telephone links for simultaneous voice/fax/data.

New products

WDS-2000i digital radios.

Telewave Booth 12071

Existing products

Transmitter combiners; receiver multicouplers; monitoring and test equipment; wattmeters; isolators; I.M. panels; high Q cavities; filters; duplexers; antennas.

New products

M107-450 low-loss transmitter combiner; TWR16-860-1RTT receiver distribution panel; Model 44AP wattmeter; T4560 dual isolator; TWPC4510 cavity; TPRD-1554 duplexer; ANT-450D6-9 antenna.

Telex Communications Booth 10075

Existing products

Wireless LAN antennas; land mobile headsets and ear microphones;

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single-line tone remote console; six-line tone remote console; digital adapter panel; 5.8GHz antennas; headsets for SWAT tactical/bicycle communications systems and combat helmet.

Teracom Components **Booth 17111**
Existing products
Mobile and portable radio auxiliary equipment; coaxial connectors and accessories; antennas and antenna system accessories; PCS infrastructure; cables; power dividers/combiners.

TESSCO **Booth 12049**

Thales Communications **Booth 13125**
Existing products
Racal 25 portable digital radio and accessories; MBITR tactical hand-held radio.
New products
Project 25 over-the-air rekey software; desktop/vehicle charger; hybrid battery cassette for forest fire use.

Thermax/CDT **Booth 13130**
Existing products
Max Form coax; Max Flex coaxial cables; mobile solutions; LTE high speed and low loss cables.

Times Microwave Systems **Booth 16063**
Existing products
Coaxial cables; connectors; assemblies.
New products
Installation tools; new connectors; Testmate test cables.

Topaz3 **Booth 11027**
Existing products
Legacy ProLine series radios; Maxon brand SP-150 series trunked/conventional radios; Maxon brand SP-200 series radios; Maxon brand community and single-user repeaters; Maxon brand SD-125 RF link modules; Maxon brand SM-400 mobiles.
New products
Maxon brand SP-200K series DTMF radios; Enduro by Maxon SM-6000 series trunking mobiles; Comstar AVL transponder and system.

Tower Connections **Booth 10111**

TPL Communications **Booth 15009**
Existing products
RF power amplifiers; VHF low band 35MHz–50MHz; high band 136MHz–175MHz; 220MHz; UHF 400MHz–512MHz and 806MHz–960MHz.
New products
Multiple amplifier series.

Transcrypt Secure Technologies **Booth 14099**
Existing products
Land mobile radio scramblers; inversion code; hopping code; AES modules; programming software; transpeaker.

Translectric **Booth 10113**
Existing products
Dc-to-dc converters; noise/spike filters; memory modules.

Transtector Systems **Booth 16079**
Existing products
APEX series ac panel protection systems; TST series; CB48RD; RMP family.
New products
RMP615A ISA surge-protected rack mount power strip for heavy duty locations; I2R ac power protection systems; ISP interior load centers; RMP-2-420A dual 20A power supply lines with outlets and rack mount.

Trident Micro Systems **Booth 11017**
Existing products
TNT series of trunking controllers; Raider and Marauder series of UHF trunking controllers; Passport trunking protocol.
New products
Network Trunking System with a digital upgrade path.

Trilogy Communications **Booth 13101**

Trimble Navigation **Booth 15119**

Troy Products **Booth 17107**

Tru-Connector **Booth 13142**
Existing products
Coaxial connectors and cable assemblies in the following series: 7/16, N, LC, LT, EIA, QDS, C, SC, HN, BNC, TNC, SMA.

TWR Lighting, Division o2wireless Solutions **Booth 11082**
Existing products
Medium intensity dual red/white strobe system.
New products
TWR model OL1-LED aviation obstruction market light; TWR model OL1-NEON aviation obstruction market light.

TX RX Systems **Booth 12027**
Existing products
Multicouplers; combiners; signal boosters; tower-top amplifiers; base station antennas; duplexers; cavity filters; other RF system products for use in the wireless industry.

United Communications **Booth 17076**
Existing products
Pagers; in-house paging systems.
New products
Eagle Patriot; Eagle Liberty; Eagle Cadet; alpha and numeric pagers; PeopleTracker Plus; in-house paging system by BrilePage.

United Telecom Council **Booth 17125**

US Tower **Booth 17101**

Valley Vision **Booth 17086**

Vancomm **Booth 17075**
Existing products
Custom antenna mounts, brackets and systems; custom monopole and BTS platforms.

VCP International **Booth 11088**

Vertex Standard **Booth 16001**

VFP **Booth 10100**
Existing products
Communications shelters for PCS, cellular, SMR, satellite and microwave industries; power modules equipped with generators and switchgear.

Vytek Wireless Products **Booth 17093**
Existing products
PTX-150 digital VHF paging transmitter; PagePro DPT-150/450 VHF and UHF paging transmitter/exciter; Skyline VHF/UHF wireless modem; PageLink VHF/UHF POCSAG data receiver/decoder.
New products
Fireline high speed UHF digital transceiver; RadioConnect broadband spread spectrum PTP link.

W&W Manufacturing **Booth 15069**
Existing products
Replacement batteries for two-way radios and BAC code scanners; battery chargers and analyzers for two-way radios; bar code scanners; cellphones and camcorders.
New products
Rapid analyzer I.

Whelen Engineering **Booth 14143**

World Tower Co. **Booth 11110**
Existing products
Drawing package on guyed and self-supporting towers; brochures on towers.

Zetron **Booth 10001**

years of history: A look back at *Mobile Radio Tech's* first year

1983

- Premiere issue: January/February. Phil Cook (Phil is now sales manager for our sister publication *RF Design*) is our first publisher at Weisner Publishing.
- In one of several changes for E.F. Johnson over the next 15 years, it merges with Western Union.
- Kenwood announces that it is entering the land mobile market.
- Mass marketing of fully programmable, off-the-shelf mobile radio is forecast, based on the new E²PROM technology.
- Novatel comes into existence through a joint venture by Nova of Calgary, and Alberta Government Telephone, of Edmonton. James L. Green is appointed as the first president.
- Shirley Bonifasi is elected president of NMRA.
- The Radio Club of America celebrates its 75th birthday.
- Jack Daniel heads the newly created Decibel western regional office.
- Hertz is the first rental car company to install cellphones in rental cars.
- Motorola supplies two-way communications equipment for the 1984 Olympic winter games in Sarajevo, Yugoslavia.
- Mal Gurian is named president of OKI Advanced Communications.
- A report drafted by former NTIA administrator Dale Hatfield states, "no new spectrum would be needed for land mobile licensees between now and the end of the century."
- Celwave Technologies Inc., a newly formed company, has acquired the telephone, cable, antenna and broadcast products business of Phelps Dodge Industries Inc.

Oakland County, MI, selects M/A-Com 800MHz network

Oakland County, MI, has selected M/A-Com, Lowell, MA, to supply a digital 800MHz radio communications system to replace the county's 10-year-old, eight-site analog trunked system. Motorola supplied the current 14-channel system.

"Our goal is to bring interoperability to all public safety agencies in the county," said Patricia Coates, CLEMIS administrator. CLEMIS is the Courts Law Enforcement Management Information System, a consortium of 80 police agencies in southeastern Michigan.

"Many of the county's police and fire agencies use various VHF, UHF and 800MHz systems that cannot talk with each other on mutual aid frequencies. The new system responds to their requests," Coates said.

Positioned north of Detroit, Oakland County has more people than the individual states of Vermont, North Dakota, Montana, Alaska, South Dakota, Wyoming, Delaware, Rhode Island, New Hampshire and the District of Columbia. With about 1.2 million residents, the county as a separate entity would rank No. 32 among metropolitan areas. At least two factors, in-building coverage and data capability, led Oakland County to select the proprietary OpenSky digital system from M/A-Com instead of sharing the state of Michigan's new Project 25 standard digital system made by Motorola.

"The state system meets the needs of state users and others in more rural areas. We don't disparage it in any way. Oakland County had specific needs for in-building coverage because we have many large office buildings such as the Palace of Auburn Hills and the Chrysler headquarters. We didn't think the state system, designed to serve vehicular radios, would take care of our needs," Coates said.

Phil Bertolini, the county's director of information technology, said the state system did not offer the option of data communications when the county was looking for a replacement radio system. He said the county's use of CLEMIS requires data delivery at a reasonable speed.

The commander of the Michigan State Police Communications Division, Capt. Thomas J. Miller, said that the state was completing a $20.3 million dollar upgrade to Motorola's new Project 25 IP voice platform that would provide future capability for integrated voice and data communications, but the data component is not funded as part of the current upgrade.

Oakland County's present system supports 1,600 mobiles and portables. Coates said that agencies that may join the new system could raise the total as high as 5,000.

Bertolini explained that some of the systems used by other agencies are aging and need replacement, which made an "enterprise solution" such as the digital system attractive to them. But he said the main purpose of the system is to achieve interoperability within the county.

As for interoperability with the state system, Coates said that the state traditionally offers one control station at a county's central dispatch facility for connection with the state system. But Oakland County differs because it includes 30 autonomous dispatch centers operated by various agencies. She said that the OpenSky digital system has gateway opportunities for interoperability, and the use of 800MHz NPSPAC frequencies requires interoperability.

Miller added: "I'm not sure how much interoperability, if any, we will be able to have between the two systems. We plan to meet with Oakland County officials to discuss it."

Plans to use 800MHz these days

Continued on next page

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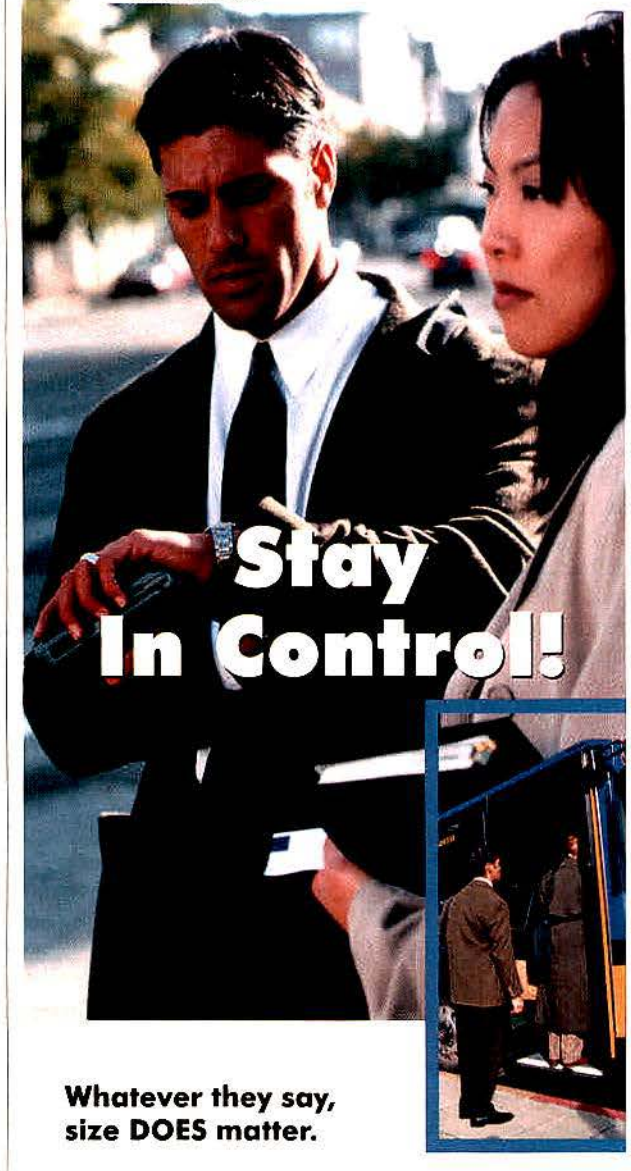

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CIRCLE (43) ON FAST FACT CARD VISIT US AT IWCE, BOOTH 11114

must take into account the potential for interference from IDEN digital commercial mobile radio systems such as those operated by Nextel Communications, Reston, VA. Coates said that the current Oakland County analog system receives a slight amount of interference, and that Nextel has been cooperating in its selection of frequencies used at its cell sites to minimize the problem.

Coates said that the new digital system is being funded by a surcharge on telephone bills. She said that a Michigan statute, Public Act 32 of 1986, as amended, allows money from the surcharge to be used for public safety agency communications, including police and fire departments.

In 1999, when the county commissioners approved the telephone bill surcharge at the maximum 4% allowed by the state, the Libertarian Party of Oakland County, among others, opposed the action. Greg Dirasian, the LPOC vice chairman, spoke at a commission hearing on the subject.

Dirasian claimed that a 1994 amendment to Public Act 32 allowed the surcharge to be used to fund emergency telephone operations, not the construction of a new radio communications system. He contended that money used for such construction should be classified as general revenue and, under Michigan law, must be voted on by the citizens of Oakland County. The commissioners approved the 4% surcharge anyway, and some of the money is being used to pay for the new radio system. *—Don Bishop*

Scanning ...

Anritsu, Richardson, TX, has appointed AF CommSupply, Lenexa, KS, as an authorized distributor of the SiteMaster handheld cable and antenna analyzers.

Southern LINC, Atlanta, has joined with Data Burst, Woodland Park, CO, to offer businesses vehicle location service. Southern LINC will provide users with a real-time tracking system, integrated with iTrak, a GPS-based device from Data Burst that is placed in the vehicle.

IDA, Fargo, ND, presented a $1,000 check to the Minn-Kota Chapter of the American Red Cross in December. The money was raised during a product promotion this past fall involving IDA dealers and resellers.

Positron Public Safety Systems' deployment Metroseguridad in Medellin, Columbia, won an award for best IT project of the year from *Computerworld Columbia* magazine. The site went live on Dec. 1, 2000, with a complement of 20 Positron Power 1-2-3 call-taking positions and 28 dispatching positions using Power CAD.

Motorola, Schaumburg, IL, is offering advanced fleet management systems for owners of Motorola CDM series professional radios. The company has certified CES Wireless mobile and base station equipment and software as compatible with CDM mobile radios that operate on any UHF conventional or LTR trunking system.

Dataradio, Atlanta, will install a mobile data network for the city of Billings, MT. The three-site, 800MHz system will support as many as 70 vehicles operating at 25.6kbps using Gemini mobile radio modems with Paragon data base stations.

Racing Radios starts dealer network initiative

Racing Radios, Forest Park, GA, has launched a dealer network initiative designed to provide the racing community throughout the United States with local product and service representation backed by Racing Radios' technical and corporate strength.

Racing Radios provides radios for the CART and Indy Racing Leagues as well as for NASCAR.

The dealer network will provide more direct support to the local racing communities across the country than was possible with the company's former operational structure.

Racing Radios will continue its national on-site support program for the sanctioning bodies it represents. Products and support will continue to be available at race venues, from the corporate offices in Forest Park and from the Mooresville, NC, and Indianapolis offices.

To facilitate the initiative, Racing Radios has closed its California office based in Santa Clarita, CA. Jim White, formerly general manager, Western area operations, whose office serviced the NASCAR Craftsman Truck Series, the NASCAR Winston West Series and the Featherlite Southwest Series has been named to head the national dealer network initiative.

Motorola to make 220MHz product for Aerwav

Motorola, Schaumburg, IL, and Aerwav, New York, have announced an agreement through which Motorola will design, manufacture and market infrastructure, portable and mobile two-way radio products for use in the 220MHz band.

"This event marks Motorola's first ever entry into the 220MHz band," said Ken Notter, Motorola Communications and Electronics vice president.

"Our agreement with Motorola establishes the type of strategic relationship that will help us advance our spectrum-leasing model," said Robert Shiver, Aerwav chairman.

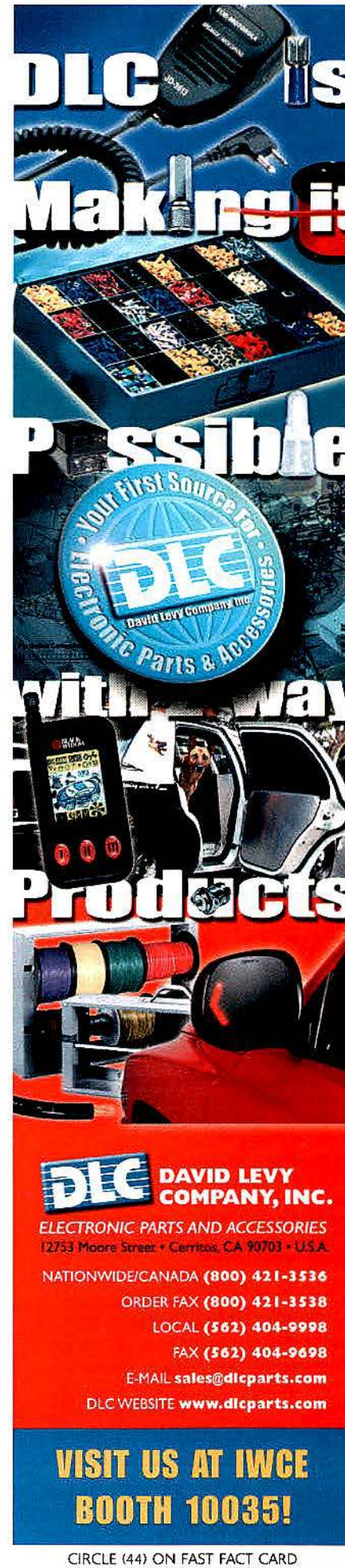
Offering two-way trunked radio features such as group dispatch, one-to-one selective calling, wide-area seamless roaming and efficient channel use, the Motorola products will be suitable for a wide cross-section of markets, according to a Motorola press release. Motorola expects to begin introducing its 220MHz products in the second half of 2002. Both companies will market and distribute these communications products directly to end users, as well as through Motorola's nationwide network of dealers.

Private Wireless Conference set for November

The annual conference sponsored by the Industrial Telecommunications Association, the Council of Independent Communication Suppliers and USMSS national organization of Motorola Service Stations will be held Nov. 6–9 at the Marriott Wardman Park Hotel in Washington, DC.

This venue offers an exhibit opportunity for manufacturers, along with training and educational programs that the conference previously didn't offer. ITA has obtained commitments from manufacturers to provide new product training and certification opportunities to market new product lines.

The conference's educational program will offer certification testing for technicians. Its business and regulatory program will explain spectrum opportunities at 700MHz and cover the status of the 800MHz band reconfiguration.



CIRCLE (44) ON FAST FACT CARD

Defense raises small hope for 138MHz–144MHz public safety sharing

The U.S. Department of Defense submitted a report to Congress in February that identifies a limited possibility of sharing the department's frequencies in the 138MHz–144MHz band.

The frequencies would be shared with state and local governments for use by public safety agencies, which the department calls "first responders." A Department of Defense Joint Spectrum Center engineering study identified ways that sharing would be possible without interfering with Department of Defense operations.

It isn't certain whether the public safety community will view the report as evidence of substantial progress toward frequency sharing. Members of the Spectrum 138–144 MHz Subcommittee of the National Public Safety Telecommunications Council who met during the APCO National Conference in Salt Lake City last August explained that the military tends to view sharing in terms of short periods of time, whereas public safety agencies want to share frequencies indefinitely in locations where their operations would not interfere with military radio systems.

The subcommittee's chairman, Vincent Stile, noted that the Department of Defense report is classified and, as such, is not yet available to the general public.

Stile said that the subcommittee gave its interpretation of "sharing" to the National Telecommunications and Information Administration, which assigns frequencies to federal users, including the military.

"I feel the Department of Defense does know what is meant from our side. These are extremely difficult times for all involved in spectrum management, and each needs to respect each other's position. But sharing is possible with good engineering and safeguards. The [Spectrum 138–144MHz Subcommittee] is ready to work with the Department of Defense as soon as possible," Stile said.

Deputy Assistant Secretary of Defense for Spectrum and C3 Policy Steven Price said, "We believe it is possible to share portions of the 138MHz–144MHz band with public safety users on a limited, coordinated basis. The Department of Defense is willing to work with National Telecommunications and Information Administration, state and local governments and first responders on a case-by-case basis to explore sharing the band for the common good."

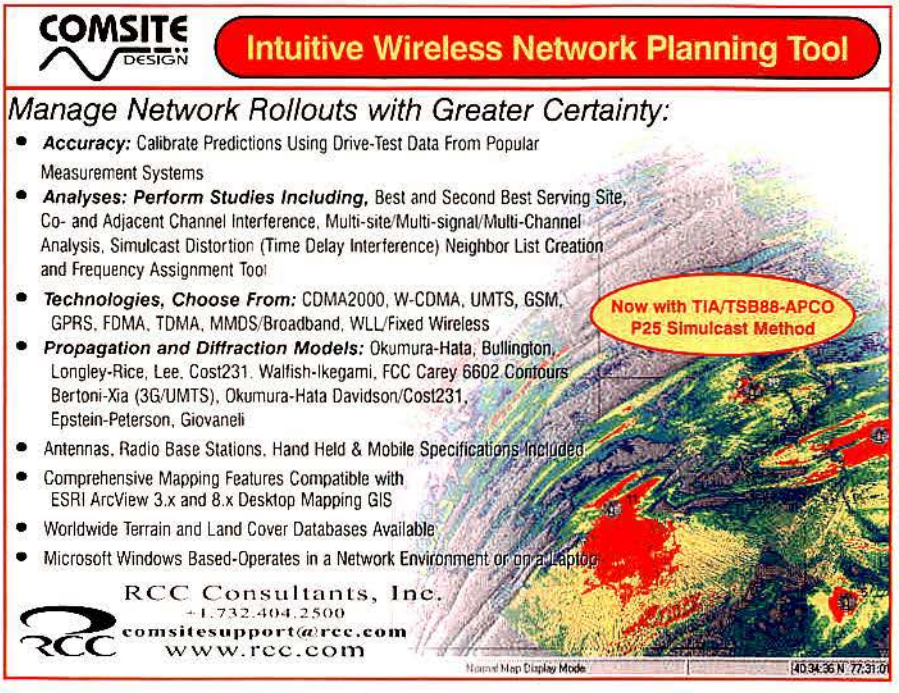
A prepared statement from the Department of Defense said that although the 138MHz–144MHz band continues to be critical to its operations, the department has found it helpful in emergencies to share communications systems with other first responders. A small number of channels may be shared on a regional basis when it is to the mutual benefit of the department and public safety officials.

The Department of Defense statement explained that the National Defense Authorization Act for fiscal 2000 reclaimed 3MHz of spectrum in the 138MHz–144MHz band for reallocation for mixed federal government and non-federal government uses. The largest federal user would be the Department of Defense. The reallocation is subject to requirements of the Balanced Budget Act of 1997.

The Department of Defense takes the position that Congress understood that the recovery of 3MHz of spectrum "was and is crucial to fulfilling DoD's spectrum requirements." Nevertheless, in the conference report, the Department of Defense was asked to provide a technical report assessing the feasibility of sharing the 138MHz–144MHz band with public safety users.

In the fiscal 2001 authorization, Congress directed the Department of Defense, in cooperation with the Justice Department and the NTIA, to provide for an engineering study with regard to spectrum sharing in the 138MHz–144MHz band. The assistant secretary of Defense for Command Control Communication and Intelligence (C3I) has submitted this report to the Senate Armed Services Committee and the House Armed Services Committee.

—Don Bishop



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Duracomm Corp.	42	32	816-472-5544
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Relm Wireless advances B&I product lines

Relm Wireless, West Melbourne, FL, might be the poster child for a company in transition—or a company about to complete one.

During the past several years, the company has transitioned from a mini-conglomerate named Adage. The companies that made up Adage were divested or dissolved and folded into the public entity of Relm. The company has become a focused land mobile radio equipment manufacturer. Relm offers two-way radio equipment under the brand names of RELM, Uniden PRC and BK Radio.

Thom Morrow, senior vice president of marketing and sales at Relm Wireless, holds a tiny 'locator' unit that plugs into BK Radio portables and mobiles to send location information to another portable, mobile or base station connected with a computer and map display.

This ESAS setup tests UHF 800MHZ crossband operation with multisite features for wide-area dispatch and seamless roaming. Vertical repeaters and amplifiers conserve rack space.

Relm's president, David Storey, said that the company's strategy begins with the use of the Total Quality System to manage quality. The strategy also relies on customer contact to achieve satisfaction with its products and keys product development to profit margins adequate for long-term success.

During the transition, Relm bridged a lack of current business and industrial radio product development by acquiring the more modern Uniden Private Radio Communication product line. Relm also has updated the Uniden enhanced subaudible signaling (ESAS) FM trunking product, adding UHF capability to fit the niche market of UHF trunking.

The basic ESAS switch costs less than $25,000 and controls as many as 20 channels. Even when used to control only five channels, an ESAS system "costs about half as much as Brand X," said Thom Morrow, Relm's senior vice president of sales and marketing. The same switch can be used to control crossband use of 800MHz and UHF channels.

Ken Klyberg, product manager, said that Relm had completed multisite dispatch system features that Uniden had begun to develop. The company is supplying firmware ESAS upgrades for Uniden mobiles and portables to allow wide-area dispatch, seamless roaming and unique IDs.

In favor of developing its own Project 25 product, Relm abandoned two previous development paths involving OEM agreements with Motorola and Racal. One reason was that the OEM units would have had a different man-machine interface than Relm's current BK Radio public safety products. Another was the reality of insufficient margins.

Storey said that a rights offering through Noble Financial Group, Boca Raton, FL, was expected to bring Relm a capital infusion between $2 million to $3 million during March to speed the company's digital radio development.

Finding firefighters in forests

Relm has developed a simple "locator" accessory that plugs into BK Radio portables and mobiles. The locator uses GPS, but Morrow said it won't be called a GPS unit because people expect GPS units to have built-in map displays. Instead, the locator accessory sends location information over a mobile or portable to any other unit, base, mobile or portable, connected with a laptop or other computer to track locations.

"For a fire or SWAT team, if there's someone with a laptop, a portable and the locator unit, you're in business. You could put it in a command or dispatch center. It's easy to use and doesn't take hours of training," Morrow said.

Using outsource manufacturing of its radio cores and in-house finish work, Relm has improved its cost control and returned to profitability in 2001. Storey said that with about 70% of its sales to going to the public safety segment, Relm expects to grow that market as the industry's "third manufacturer of a portable and second manufacturer of a mobile." And with a schedule to introduce new business and industrial product that Storey described as "aggressive," he expects Relm to increase that side of the business, too.

—Don Bishop

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Pack Your Suitcase

March

13: Region 5 700MHz Planning Committee meeting, 10 a.m., Orange County Communications, Orange, CA. Contact: David Buchanan at 909-387-3337 or **www.cpra.org.**

17–19: UTC Canadian Utility Telecom Conference, Pan Pacific Hotel, Vancouver, British Columbia, Canada. Contact: Elissa Ehrenstein at 202-833-6827 or **www.utc.org**.

18–20: CTIA Wireless 2002, sponsored by the Cellular Telecommunications and Internet Association, Orange County Convention Center, Orlando, FL. **www.ctiashow.com.**

April

7–10: ENTELEC, George R. Brown Convention Center, Houston. **www.entelec.org**.

11: Region 24 700MHz Planning Committee meeting, 1 p.m.; 800MHz meeting, 10 a.m., Kansas City Police Department Communications Division Conference Room, Kansas City, MO. Contact: Stephen Devine at 573-526-6105 or *sdevine@mail.state.mo.us*.

23–24: British Association of Public-Safety Communications Officers, organized by Brintex, Novotel London West Convention Center, Hammersmith, London. **www.bapco.co.uk.**

24–26: International Wireless Communications Expo, co-sponsored by *Mobile Radio Technology*, Las Vegas Convention Center, Las Vegas. **www.iwceexpo.com.**

25: Simulcast Forum, Simulcast Solutions, Las Vegas Convention Center, 8 a.m., East lobby, S2, Las Vegas. **www.simulcastsolutions.com.**

28–5/1: APCO North Central Regional Conference, sponsored by the Wisconsin Chapter of APCO, Madison, WI. **www.apco2002.com.**

May

6–10: Vehicular Technology Spring Conference, sponsored by IEEE, Birmingham-Jefferson Civic Center, Birmingham, AL. **www.ieee.org**.

15–17: 5th Annual PCIA Tower and Site Management Forum, sponsored by the Personal Communications Industry Association, Westin Diplomat Resort & Spa, Hollywood, FL. Contact: Poppie Bergere at 800-759-0300 ext. 7433 or **www.pcia.com.**

20–23: ASCENT Spring Conference, sponsored by the Association of Communications Enterprises, Paris Las Vegas Hotel, Las Vegas. **www.ascent.org.**

June

2–6: Supercomm, sponsored by TIA and USTA, Georgia World Congress Center, Atlanta. **www.supercomm2002.org.**

16–20: NENA, sponsored by National Emergency Number Association, Indianapolis. **www.nena9-1-1.org.**

23–26: UTC Telecom, sponsored by UTC, the United Telecom Council, MGM Grand, Las Vegas. **www.utc.org.**

August

11–15: APCO Conference & Exposition, sponsored by the Association of Public-Safety Communications Officials–International, Opryland Hotel, Nashville, TN. **www.apcointl.org.**

September

17–20: PCIA GlobalXChange, sponsored by the Personal Communications Industry Association, Ernest Morial Convention Center, New Orleans. **www.pcia.com.**

October

5–9: 109th Annual IACP Conference: Law Enforcement Education Technical Exposition, Minneapolis. **www.theiacp.org.**

November

6–9: ITA Annual Conference, Marriott Wardman Park Hotel, Washington. 703-528-5115 or **www.ita-relay.co** .

22: Radio Club of America Annual Awards Banquet and Technical Symposium, New York Athletic Club, New York. **www.radio-club-of-america.org.**

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Mobile radio switches between equipment

The **EF Johnson** 5300 analog/digital mobile radio provides an APCO Project 25-compatible and SmartNet/SmartZone interface to meet the needs of state, local and federal government users, as well as business, industrial and public safety applications. With backward compatibility, this mobile offers the capacity to communicate in narrow and wide channels and to operate in either digital or analog mode. This allows the radio to effectively switch from communications between SmartNet/SmartZone, APCO 25-approved equipment and conventional FM equipment with a turn of the channel knob.

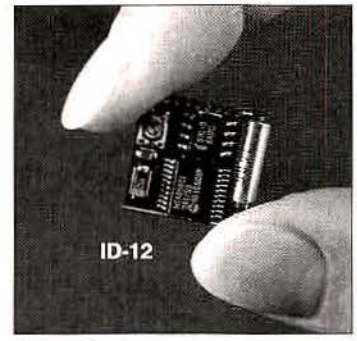
WWW.EFJOHNSON.COM

Radios available in low-band, UHF models

Patriot RPM series mobile radios from **Ritron** are available in low-band (30MHz–50MHz), VHF (146MHz–174MHz) and UHF (450MHz–470MHz) and with power levels of 60W, 30W and 25W, respectively. The radios feature 16 channels and are PC field-programmable for simplex, half-duplex or receive-only operation. Other features include: wideband operations, cloning capability, normal and/or priority scan, CTCSS, digital coded squelch, two-tone sequential decode, busy channel lockout, channel monitor lock-out and transmitter time-out timer. The mobile measures 2.1" × 5.8" × 7.4", permitting easy installation.

WWW.RITRON.COM

Digital ANI MDC-1200® Signaling



CSC | CONTROL SIGNAL

www.ControlSignal.com

Control Signal's ID-12/1201 is an economical **MDC-1200** ANI system. The ID-12 encoder works in all radios and fits in virtually all handhelds and mobiles. The ID-1201 decodes any **MDC-1200** ANI signal, has a large LED display, a printer port and an RS232 port.

MDC-1200 is a registered trademark of Motorola Inc.

800-521-2203 • 303-989-8000 • Fax 303-989-8003 • www.ControlSignal.com

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Radio increases spectrum efficiency

M/A-Com's OpenSky M-803 mobile radio uses digital TDMA technology to increase spectrum efficiency and provide secure voice and data radio at a 19.2kbps data rate. Features include trunked voice and data, IP and CDPD-based open interface for real-time mobile data applications, full-duplex operation for rapid data transfer, integrated GPS for automatic vehicle location and over-the-air software downloading. The radio offers multimode operation for compatibility with conventional FM and APCO P25 common air interface.

WWW.MACOM.COM

Digital radio supports Project 25 application

The Guardian G25RMV100 VHF P25 conventional mobile from **Datron World Communications** is designed for government, public safety and business applications. This fully digital radio meets the APCO P25 FDMA common air interface standard. It also operates as an analog radio, offering full backward compatibility with conventional wideband FM systems.

WWW.DTWC.COM

Radio suited for industrial complexes

The six-channel industrial radio from **GAI-Tronics** can be used for stand-alone radio communications or can be integrated to work with other communications equipment such as the page/party system. The radio is a stationary, mounted UHF transceiver suited for industrial complexes, especially in cranes or other mobile equipment.

WWW.GAI-TRONICS.COM

Analog converters accept wide range input

Entrelec's single and multifunction analog converters feature approval for UL 1604 Class I, Div. 2 groups A, B, C and D hazardous locations and nonhazardous locations. These compact, 22.5mm wide, DIN rail-mounted converters accept a wide range of input signals and supply standard voltage and current output. The full line includes the C.A.I.S UNI family for many features and performance, and the C.A.I.S.-E family for popular analog signal conversion applications.

WWW.ENTRELEC.COM

System provides fleet management

Axiom Navigation's AccuTracker FMS-2000 provides efficient fleet management as well as employee and service accountability. The system, when combined with third-party software, runs detailed reports to check route efficiency, pinpoint where cargo is disappearing and check on drivers. The system is a 12-channel GPS receiver paired with a full short-range 900MHz data transmission system. The base station software supports anywhere from one vehicle to hundreds of vehicles. Each unit can be programmed to log time, distance, speed and stops. With the unit's small size, stealth installation is easily performed.

WWW.AXIOMNAV.COM

Monitor provides RF sensing, remote access

The DB8822 integrated power monitor from **Decibel Products** is a sensor and display monitor for SWR and power on a single transmitter or antenna. It combines RF sensing, display, monitoring functions and remote access in one compact package. Various models are available for frequencies from 30MHz–1,000MHz, and power ranges from 100W–1,000W. User-set parameters allow a wide range of configurations without complicated setup procedures. The monitor requires 9Vdc–32Vdc and will draw about 75mA at maximum 12Vdc.

WWW.DECIBELPRODUCTS.COM

Accessories help customize radios

The EX500 portable two-way radio from **Motorola** offers accessories designed to enable EX500 users to customize their radios to fit their unique applications. The audio accessories offered include a lightweight headset with boom microphone and an inline PTT button, an ear microphone with VOX/PTT radio interface module and a high-noise-level ear microphone. Carry case options include a plastic carry holster or a soft leather case with swivel belt clips. Users can replace the standard NiCd rechargeable battery with a 1,000mAh or 1,320mAh Li-ion battery when extended work cycles are needed.

WWW.MOTOROLA.COM

Product Encore

Transmitter offers weather resistance

The Quick Talk model from **Ritron** integrates digital voice recording technology with a PC-programmable 6W radio transmitter. This weather-resistant transmitter monitors as many as two contact closure/switch inputs and transmits custom voice messages over any VHF or UHF radio system. Line-of-sight coverage can be achieved through a radio repeater.

WWW.RITRON.COM

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THUNDER EAGLE, INC. Wireless Alerting Systems

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Products meet FCC Part 15 regs

The connectors and adapters from **RF Connectors** meet FCC Part 15 regulations by incorporating reverse, or left-handed, threads. Standard coaxial connectors will not mate with these connectors, making the connector Part 15-compliant. Because only the threads are modified, performance of these coaxial connectors is unchanged.

WWW.RFINDUSTRIES.COM

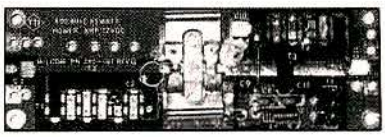
Radio provides secure Internet

Harris' RF-5800-V-NM VHF networking module provides secure, wireless Internet protocol connectivity for tactical applications such as remote sensors or "smart" munitions. The radio uses the Harris Tactical Networking software, which uses a channel access mechanism to provide high network throughput, automatic data rate detection and prioritized traffic. It can withstand ground-mobile shock and vibration, and it covers the military VHF band for use anywhere.

WWW.HARRIS.COM

Crescend Technologies

RF Amplifiers & Modules



540-051 K45 860-866 MHz 45 Watt Replacement Module

850-870 MHz Module

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- VHF Low Band
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Crescend Technologies, LLC
Phone: 800 872 6233 Fax: 847 593 1320
www.CrescendTech.com email: sales@crescendtech.com

CIRCLE (49) ON FAST FACT CARD

Two-way radio offers 1,800-plus talk channels

The FreeTalk XLS (Model TK-3131) two-way radio from **Kenwood Communications** offers more than 1,800 talk channels and a communicating range of four miles. It offers features such as voice encryption, channel scanning, vibration alert, an illuminated LCD and automatic battery-saver functions. It comes equipped with 15 main channels, each with 38 analog talk groups and an additional 83 digital talk groups. The radio is compatible with widely used FRS radios.

WWW.KENWOOD.NET

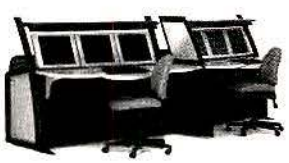
Software assigns citation numbers

A new feature of **Motorola's** Premier MDC reporting can enhance accuracy by reducing the need for officers to manually enter numbers issued through dispatch or other conventional methods. Now when an officer writes a citation, a state-issued citation number will be automatically and wirelessly assigned to that citation so it can be tracked. Once the citation is completed, reported details can be shared quickly through wireless transmission to headquarters for routing, approval and notification. The citation numbers are stored on the server. Officers fill out the citation on their laptops, and when the citation is completed the number is automatically generated and included on the report. The software also provides customized administrative tools for generating citation reports.

WWW.MOTOROLA.COM

Console designed for flat screen

Winsted's slim-line consoles are designed for the flat screen monitors used in command and control centers, security systems, traffic management, network operating centers and broadcast control rooms. Its space-saving console depth of 18½"-plus work surface affords compact room installations. The consoles are made of steel with baked, black enamel. The work surface can be formed to any shape or size and can include cutouts for adjustable keyboard shelves. All edges on this shelf are smooth and rounded in a white matrix finish. All components are interchangeable for flexibility in console configuration.



WWW.WINSTED.COM

Undercover antennas mirror cell antennas

STI-CO's glass mount VHF/UHF or VHF/cellular mobile antennas are disguised for law enforcement officials or undercover task force units. The dual-band antennas look like the glass-mount cellular antennas seen on many vehicles and may be mounted on the rear or side windows. The antennas offer a 16", closed-coil black whip that can be adjusted to a 90° angle to compensate for variances in window slopes. A discreet 3" whip attaches to the coupler housing inside the vehicle for cellular.

WWW.STI-CO.COM

Batteries intrinsically safe, non-incendive

The rechargeable replacement batteries for Ericsson/GE LPE series and MRK series radios from **Multiplier Industries** meet the demands of intrinsically safe and non-incendive batteries being required for use by government agencies and other organizations such as fire departments, oil refineries, mining and natural gas companies.

WWW.MULTIPLIER.COM

Antenna blends easily

Decibel Products' DB792SM5N-KU wideband antenna provides omni-directional RF coverage in the 1,710MHz–3,600MHz band. This antenna is a direct response to modern indoor wireless coverage systems that require versatile antennas that provide maximum services while remaining physically appealing. The shape factor of the antenna blends into an interior environment.

WWW.DECIBELPRODUCTS.COM

Technology provides recording/retrieval

Dictaphone and **The Genesis Group** have joined to provide voice recording and retrieval capabilities for users of Motorola SmartZone, SmartNet and other trunked radio systems. Genesis has integrated Dictaphone's Freedom digital recording system with its GenWatch and GenSZAI trunked radio system management and billing products.

WWW.DICTAPHONE.COM
OR WWW.GENESISWORLD.COM

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T-5

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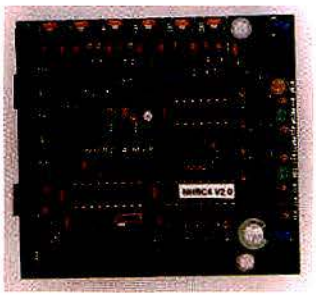
Monitor tests AM/FM systems

The communications service monitor from **IFR Systems** tests conventional AM and FM radio systems up to 1.05GHz. The 2944 monitor is for maintenance, repair and field-testing of AM/FM analog receivers, transmitters and repeaters. The monitor is rugged, versatile and lightweight. It combines a number of instruments into one convenient box, allowing users to make exacting measurements whether they are in the workshop or in the field. The monitor's features include full-span spectrum analyzers, narrowband and broadband power meters, audio analysis tools, a full-featured signal generator and a digital storage oscilloscope.

WWW.IFRSYS.COM

Controller installs mobile radios, stations

The NHRC-4/MVP repeater controller from **NHRC** is an integrated repeater controller that installs General Electric Custom MVP mobile radios and stations. It provides complete repeater operation and control with a remote base port.



In mobile radio, two wires must be added, one trace is severed on the radio's system board and the controller is plugged in. In station applications, installation consists of adding three wires and then the controller is plugged in. Features include individual timeout timers, five courtesy tones indicating channel activity and a digital output for control applications.

WWW.NHRC.NET

Digital direction finder targets cellular phones

Communications Test Instruments' Locator XPD digital TDMA cellular direction finder system for cellular system operators and law enforcement workers tracks and locates digital TDMA cellphones. The system will track and geographically locate and target cellphones by presenting a real-time display of the tracking vehicle and bearings to the target cellphones superimposed on a moving map display. This compact, integrated product is designed specifically for use in a mobile environment, and when installed in a tracking vehicle, requires no additional hardware or software to begin tracking operations. The system brings several technologies together into a single operating platform controlled by a small vehicle-mounted computer.

E-MAIL: PFSSALES@IME.NET

Loop test system isolates problems

The 51950 system from **Proctor and Associates** is a dedicated test system that allows a single technician to quickly identify leased or private line problems without the need for any specialized equipment or additional help. It verifies transmission levels through two-wire or four-wire circuits and reports the results to the operations technician. The technician analyzes the results, isolates the problem span and dispatches the appropriate repair workers directly to the trouble site. Through its remote operation, the technician can conduct testing from any off-site location. The system can also detect and report alarm conditions at the remote transmission site via remote alarm connections. The system monitors the remote site and automatically reports back to the operations center, alerting security of any detected security breaches, fires or backup power switch-overs. Security can also dial the system at any time to determine the site's status.

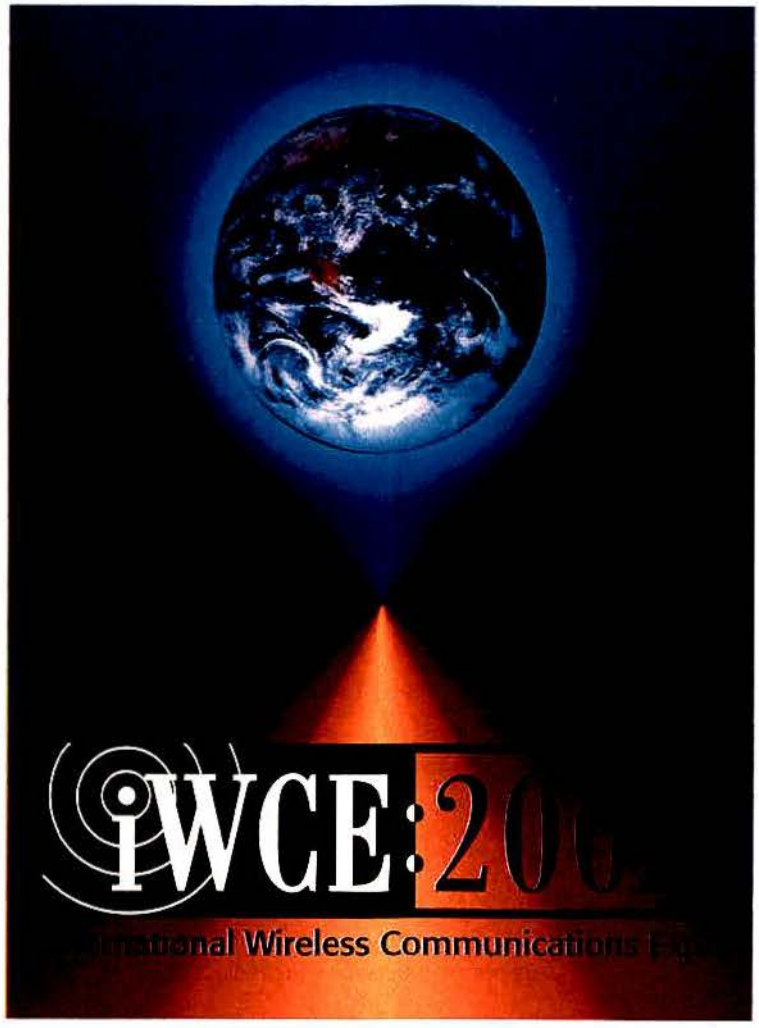
WWW.PROCTORINC.COM

Adapter simplifies battery connection

Cadex's Flexarm adapter snaps into the Cadex 7000 series battery analyzers to simplify connecting batteries for testing. This adapter establishes contact by lowering the arms to the battery. Magnetic guides keep the battery in any position. The gold-plated Pogo contacts are field replaceable. A spring-loaded temperature sensor monitors the battery temperature. Banana jacks allow cable connection on batteries fitted with a plug rather than flat contacts. The analyzer's "edit" key prompts the user to enter the battery specifications, which are stored in the adapter. There is room for 10 battery types, each of which can be given a unique name.

WWW.CADEX.COM

Conference and Show Information



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Schedule of Events

Registration Hours

Monday, April 22 (Workshops Only)	8:00am-9:00am
Tuesday, April 23 (Workshops Only)	8:00am-9:00am
Tuesday, April 23	12:00pm-5:00pm
Wednesday, April 24	8:00am-5:00pm
Thursday, April 25	8:00am-5:00pm
Friday, April 26	8:00am-2:00pm

PCIA Workshop

The 21st Century Radio Dealer

Wednesday, April 24
10:30am-12:00pm

Base Station Workshops

Radiation Safety

Monday, April 22

8:30am-12:30pm
Telecommunications Grounding Practices

12:30pm-1:30pm
Lunch

1:30pm-5:30pm
RF and Microwave Basics

9:00am-5:00pm
(12:30pm-1:30pm Lunch)
Radiation Safety and FCC Compliance for Wireless Telecommunications Professionals (Day 1)

Tuesday, April 23

8:30am-12:30pm
Basics of Mobile Radio

12:30pm-1:30pm
Lunch

1:30pm-5:30pm
Civil Engineering For Telecom Professionals

9:00am-12:30pm
(12:30pm Lunch)
Radiation Safety and FCC Compliance for Wireless Telecommunications Professionals (Day 2)

Wednesday, April 24

8:30am-12:30pm
Implementing Mobile Data Systems

12:30pm-1:30pm
Lunch

Wednesday, April 24

9:00am-10:00a
10:00am-5:00p
1:00pm-1:45p
2:00pm-2:45p
3:00pm-3:45p
4:00pm-4:45p

Thursday, April 25

7:30am-9:00a
9:00am-9:45a
10:00am-10:45a
10:00am-5:00p
11:00am-11:45a
1:00pm-1:45p
2:00pm-2:45p
3:00pm-3:45p
4:00pm-4:45p

Friday, April 26

9:00am-9:45a
10:00am-10:45a
10:00am-2:00p

Business Track

Regulatory Track

Public Safety Track

Keynote Address

Exhibit Hall Open

Business Track	Regulatory Track	Public Safety Track
(B1) Insuring Your Business	(R1) The Status of VHF/UHF Trunking	(P1) AGILE
(B2) Advertising and Marketing For Beginners and Old Hands	(R2) Leasing 700 MHz Guardbands	(P2) NPSTC
(B3) The Telecommunications Development Fund	(R3) Nextel's White Paper	(P3) Opensky
(B4) Leverage	(R4) Interconnection Update	(P4) P25

RCA Breakfast Meeting

(B5) Buying and Selling Telecommunications Assets	(R5) Auction Dust Settlings	(P5) The World Trade Center
(B6) The Tower Market	(R6) The ULS Tutorial	(P6) Nextel

Exhibit Hall Open

(B7) Tower Paper	(R7) Update of 220-222 MHz Band Use	(P7) Nextel Panel Discussion
(B8) ROI (Return On Investment)	(R8) FCC Open Forum	(P8) Project Greenhouse
(B9) Solving RF Exposure Issues in a Cost Effective Manner		(P9) Project MESA
(B10) LLC: Is it Right For You?	(R9) Leasing and Managing Channels	(P10) Tower Safety
(B11) Mobile Data Business	(R10) AVL in the Mix	(P11) Telematics
(B12) Employment Contracts and Non-compete Clauses	(R11) FCC Speed Traps	(P12) PSWN
(B13) Bankruptcy Defense	(R12) FCC Update	(P13) NYSTEC

Exhibit Hall Open

Special Events

We look forward to seeing you at some of the industry events at IWCE 2002.
Visit www.iwceexpo.com for updates and additions to the IWCE 2002 special events program.

Tuesday, April 23

1:00pm-4:00pm
TETRA Seminar

The North American TETRA Forum (NATF) will be hosting a special seminar on the advantages of adopting TETRA in North America. The seminar will include presentations by leading manufacturers and users of TETRA.

There is no cost to attend the seminar, but pre-registration is required. To pre-register, please e-mail your name, company name, job title, address and phone number to info@tetraforum.org. The deadline to register is April 2, 2002.

Wednesday, April 24

9:00am-10:00am
IWCE 2002 Keynote Address Presented by Jay Kitchen, CEO PCIA

As president and CEO of the Personal Communications Industry Association (PCIA), Jay Kitchen is one of the foremost leaders in the wireless communications industry.

Kitchen assumed the presidency of PCIA in 1994. Since then, he has overseen the growth of PCIA to encompass the broad cross-section of the economy that makes up the mobile convergence space. During Kitchen's tenure, PCIA has evolved to meet the challenges of an increasingly complicated and competitive telecommunications market. He has developed and fine-tuned PCIA's core competencies of providing valuable business solutions, removing barriers to business growth on a global scale, gathering and sharing international and country-specific marketplace intelligence and advocating for public policy on behalf of its members. He has leveraged those unique and proven member services to launch industries such as PCS, and to facilitate the growth of mobile convergence.

Wednesday, April 24

10:30am-12:00pm
PCIA Workshop
The 21st Century Radio Dealer

It's no longer enough to be just a "two way radio dealer." The 21st Century Radio Dealer must be knowledgeable in an ever-increasing variety of wireless solutions and be agile enough to implement different technologies for a wide panaply of customers. From wireless LANs to being an ISP, from being a reseller to being an m-commerce expert, today's marketplace demands more of today's dealer. In this session sponsored by PCIA, learn what opportunities there are, and what resources are available to you, so that you can be the "go-to" dealer in your market.

Thursday, April 25

7:30am-9:00am
RCA Breakfast Meeting

Monte Carlo Resort and Casino

Attend the annual Radio Club of America breakfast meeting at IWCE 2002. This is your opportunity to network with other club members in a relaxed atmosphere. Enjoy the keynote presentation which addresses critical industry issues. Reservations are required. Register at the Radio Club of America booth #16049 on Wednesday, April 24 or contact Karen Clark at kclark@primediabusiness.com or 1-720-489-3286. Visit the RCA booth #16049 throughout the IWCE 2002 show.

2:00pm-3:00pm
Women in Wireless Communications

Room S221, Las Vegas Convention Center

WIWC invites you to a Social Hour during the IWCE show in Las Vegas. Come relax, meet others in the industry and learn more about Women in Wireless Communications. Refreshments and hors d'oeuvres will be served. Please R.S.V.P. to Patti Ryg, Hutton Communications, at 877-832-6337. There is a $5 fee to attend.

EXHIBITING COMPANIES

as of 1/31/02

1st Contact Technologies Inc.
A.C. Data Systems
A&R Telecom Inc
A.W. Enterprises
AC-DC Industries
ACE Technology, Inc.
Adtran
Advance Label & Tag
Advanced Charger Technology
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AEA Wireless
Aerocomm, Inc.
AF CommSupply
Alexander Technologies
Alltec Corp
Amerizon Wireless Wholesale Communications Distrib
Amplifier Research
Amrel Systems L.L.C.
AMTA/TWTA
Anchor Graphics Inc.
Andrew Corportion
Anritsu Co.
Antenex Inc.
Antenna Plus
Antenna Specialists
APCO International
Astratec Electronics Inc.
Astron Antenna Co./Northpoint Communications Prod.
Astron Corp.
Atlantic Scientific Corp.
AVTEC Inc.
Bard Manufacturing Co.
BEE Electronics Inc.
Cadex Electronics Inc.
Carlson Wireless Technologies
Catalyst Communications Technologies Inc.
Cellport Systems
Centurion Wireless Technologies, Inc.
CeoTronics Inc.
CES Wireless Technologies Corp.
ChargeGuard Inc.
Childs Antennas Corp.
Cimarron Technologies Corp.
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Computer Resources Inc.
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Cyterra Corporation
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Exhibit Hall Hours

Wednesday, April 24
10:00am-5:00pm

Thursday, April 25
10:00am-5:00pm

Friday, April 26
10:00am-2:00pm

Interested in exhibiting at IWCE?

Contact:
Mike Doolitle,
Exhibit Sales Manager
Phone: +1-720-489-3137
Fax: +1-720-489-3101
mdoolittle@primediabusiness.com

GENERAL INFORMATION

Location

Las Vegas Convention Center
3150 Paradise Road
Las Vegas, NV 89109-USA

Registration Information

Registration Hours

Monday, April 22 (Workshops Only)	8:00am-9:00am
Tuesday, April 23 (Workshops Only)	8:00am-9:00am
Tuesday, April 23	12:00pm-5:00pm
Wednesday, April 24	8:00am-5:00pm
Thursday, April 25	8:00am-5:00pm
Friday, April 26	8:00am-2:00pm

Badges

If your registration is received by April 5, your badge will be mailed to you. After April 5, please pick up your badge at the "Pre-Registered Attendees" counter at the show. After April 12, please register at the show.

Hotel Information

Hotel Reservations

The Monte Carlo Resort and Casino is the official hotel for IWCE 2002. Hotel reservations are available at the discounted show rate of $105/night (Sunday - Thursday), $145/night (Friday or Saturday).

Monte Carlo Resort and Casino
3770 Las Vegas Blvd. South, Las Vegas, NV 89109
Call: +1-702-730-7000 or 1-800-311-8999 for reservations
Group Code: XIWCE

Monte Carlo is now accepting room reservations for IWCE 2002. These rooms are offered on a first-come, first-served basis. Rates may increase after March 15, 2002, so call today! Be sure to mention the group code, XIWCE, to qualify for the special rate!

Shuttle Service

Shuttle service will be provided from the Monte Carlo to the Convention Center, free of charge, as follows:

Wednesday, April 24	8:30am-5:30pm
Thursday, April 25	8:30am-5:30pm
Friday, April 26	8:30am-3:00pm

Travel Information

PRIMEDIA Business Exhibitions has selected **Stellar Access, Inc. (SAI)** as the official event travel service. Book online at www.iwceexpo.com or call 1-800-929-4242 and ask for Group #326 to receive the following discounts:

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Save 5% to 10% on lowest applicable fares with an additional 5% off with a 60 day advance purchase. All rules and restrictions apply. Travel between April 19-30, 2002.

Alamo Rent A Car
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Book Online. Pay no transaction fee!
As an added convenience for all members, PRIMEDIA Business Exhibitions has arranged for you to book your travel to this event online. You can make your air and car reservations using the special contracted rates that PRIMEDIA Business Exhibitions has negotiated for you directly from the IWCE Web site at **www.iwceexpo.com**!

If you do not wish to book online,
contact Stellar Access, Inc. at:
1-800-929-4242
Outside US & Canada: 619-232-4298
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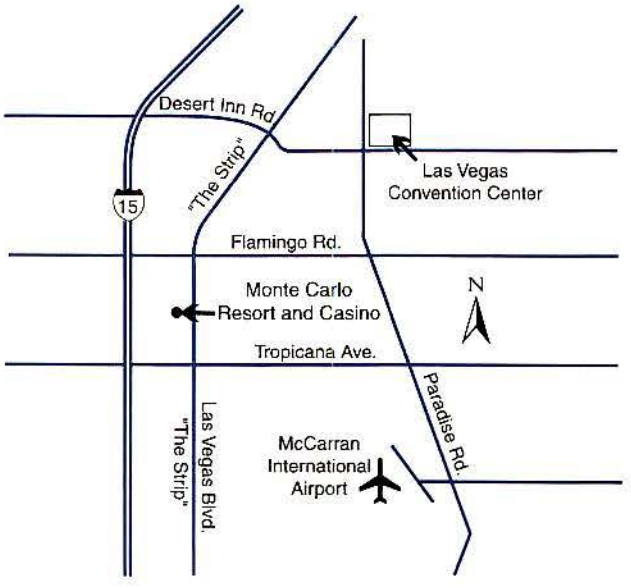
A $15 transaction fee will be applied to all tickets purchased via phone service.
Reservation hours: M-F 6:30am-5:00pm Pacific Time.
Be sure to reference Group #326.



IWCE:2002

International Wireless Communications Expo

April 24-26, 2002
Las Vegas Convention Center
Las Vegas, Nevada USA

ADVANCE REGISTRATION

Please complete all questions. Photocopy for additional registrants. Incomplete forms cannot be processed. Must be 18 years of age to attend. Photography is prohibited in the exhibit hall. You will receive confirmation if you register before April 15, 2002.

REGISTER ONLINE AT www.iwceexpo.com

1. General Information

Mr. ❑ Ms. ❑ Mrs. ❑

First Name _____

Last Name _____

Title _____

Company _____

Address _____

City _____ State _____

Zip _____ Country _____

Phone* _____ Fax* _____

International guests, please include city and country codes.

E-mail _____

*By providing, you grant PRIMEDIA Business Exhibitions permission to contact you via e-mail regarding your registration as well as to receive updates on IWCE and/or updates and promotional material from exhibitors.

Source Code: BR

❑ Please check here if you require special services.

2. Profile Information

1. Do you wish to receive/continue to receive *Mobile Radio Technology?* ❑ Yes ❑ No

Signature (Required) Date

2. What best describes your primary business? (check only one)

Public Safety and Government

- AA ❑ Law Enforcement Agency
- AB ❑ Fire Department
- AC ❑ Health/Emergency Services
- AD ❑ State/Local Governement
- AE ❑ Federal Government/Military

Dealer

- AF ❑ Mobile Radio Dealer and/or Service Shop

Service Provider

- AG ❑ Community Repeater Operator
- AH ❑ Specialized Mobile Radio System Operator
- AI ❑ Paging System Operator
- AJ ❑ Enhanced Specialized Mobile Radio System Operator
- AK ❑ PCS Telephone System Operator
- AL ❑ Cellular Telephone System Operator
- AM ❑ Satellite System Operator

Business, Transportation and Other

- AN ❑ Utility
- AQ ❑ Other Business and Industrial Users

(please specify)

- AR ❑ Motor Freight
- AS ❑ Other Transportation

(please specify)

- AT ❑ Engineer/Consultant Firm
- AU ❑ Manufacturer of Communications Equipment
- AV ❑ Manufacturer's Rep/Distributor of Communications Equipment
- AP ❑ Press/Media*
- AO ❑ Other _____ (please specify)

*If registering as Press/Media, please send credentials with this form.

Sales and Distribution

- AW ❑ Distributor
- AX ❑ Agent
- AY ❑ Retailer
- AZ ❑ Exporter/Importer

3. What is your title? (check only one)

- BA ❑ Corporate (President, Owner, CEO, VP, Partner, General Manager)
- BB ❑ Operations and Administrative (Director, Manager, Administrator)
- BC ❑ Technical and Engineering (VP, Director; Manager; Technician, Specialist, Supervisor and Administrator of Engineering, Technical Support, and Quality Control)
- BD ❑ Sales/Marketing
- BE ❑ Base Station Mgmt.
- BO ❑ Other _____ (please specify)

4. What are your interests?

- CA ❑ Two-way Radio
- CB ❑ Paging
- CC ❑ Cellular
- CD ❑ PCS
- CE ❑ Mobile Data
- CF ❑ RF Design/Components
- CG ❑ Base Station Equipment
- CH ❑ Systems Integration
- CI ❑ Satellites
- CJ ❑ ITS
- CK ❑ Other _____ (please specify)

Speciality Wireless Applications

- CL ❑ GPS
- CM ❑ RF Identification
- CN ❑ Remote Terminal Communication
- CP ❑ Wireless Local Loop
- CQ ❑ Telemetry
- CR ❑ Wireless Billing
- CS ❑ Mobile Office
- CO ❑ Other _____ (please specify)

5. What best describes your purchasing role? (check only one)

- DA ❑ Make final decision to purchase product
- DB ❑ Recommend/specify products for purchase
- DC ❑ No purchasing role

IWCE:2002
International Wireless Communications Expo

April 24-26, 2002
Las Vegas Convention Center
Las Vegas, Nevada USA
www.iwceexpo.com

First Name _____ Last Name _____
(Important in the event that pages get separated.)

3. Program Registration

■ IWCE CONFERENCE AND EXHIBITS

		Through 3/22/02	After 3/22/02
C	❑ **IWCE Conference & Exhibits** (for all three days)	$490	$590
W	❑ **Wednesday Conference & Exhibits** (for all three days)	$260	$310
R	❑ **Thursday Conference & Exhibits** (for all three days)	$260	$310
F	❑ **Friday Conference & Exhibits** (for all three days)	$260	$310
E	❑ **Exhibits Only** (for all three days)	$50	$60

IWCE Conference and Exhibits Registration Subtotal: $ _____

■ IWCE PREMIUM PACKAGE

IWCE conference/exhibits and either Base Station Workshops or RF Safety Compliance Series (Not available after 3/22/02)

PW	❑ **Premium Package with all 5 Base Station Workshops**	$1025
PS	❑ **Premium Package with RF Safety Compliance Series**	$1025

■ RADIATION SAFETY & FCC COMPLIANCE SERIES

On a space available basis only. *Register for this day and a half series for one inclusive price. Includes IWCE 2002 exhibit pass for three days.*

RS	❑ Series course	$600	$700

RF Safety Compliance Series Registration Subtotal: $ _____

■ BASE STATION WORKSHOPS

On a space available basis only. *Register for as many workshops as you would like. Save $ when you register for the entire workshop series. Includes IWCE 2002 exhibit pass for three days and course materials. Lunch is included. Please check box to indicate which workshops you plan to attend.*

Monday, April 22

❑ W1 8:30am-12:30pm ❑ W2 1:30pm-5:30pm

Tuesday, April 23

❑ W3 8:30am-12:30pm ❑ W4 1:30pm-5:30pm

Wednesday, April 24

❑ W5 8:30am-12:30pm

WB	❑ Entire Base Station package (5 classes)	....$800	$950
WO	❑ One class (select above)	.....$275	$380
WM	❑ Two, three or four classes (select above)	....$225 *ea.*	$320 *ea.*

Base Station Workshops Registration Subtotal: $ _____

TOTAL REGISTRATION FEES: $ _____

****After April 12, 2002, please register on site.***
Badges will be mailed if registration form is received by April 5, 2002. Otherwise, please pick up your badge at the "Pre-registered Attendees" counter on site.

4. Method of Payment

❑ Check #_____ enclosed. Make payable to IWCE 2002.

Check one: ❑ American Express ❑ MasterCard ❑ Visa

Credit Card #_____ Exp. Date_____

Print Name _____

Signature (required)_____ Date_____

CANCELLATION POLICY: Primedia Business Exhibitions will offer a refund less a 25% administrative fee as follows: Requests for refunds must be made in writing and postmarked or fax stamped no later than March 22, 2002. Refunds will not be issued for amounts less than $100. Substitutions are welcome in lieu of cancellations. No refunds or credits will be issued after March 22, 2002. Please allow four to six weeks for processing.

5. Send Completed Form and Payment

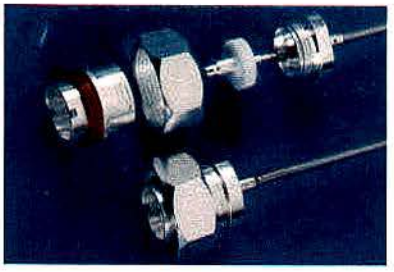
FAX with credit card information to: **+1-508-759-4552**

MAIL to: Convention Data Services
IWCE 2002 Registration
107 Waterhouse Road
Bourne, MA 02532 USA

Please do not mail in registration form previously faxed and risk duplicate billing.

Questions regarding your registration?
Call IWCE Registration at +1-508-743-0105
E-mail: trade_shows@primediabusiness.com
Visit www.iwceexpo.com

Plug features low intermodulation



Tru-Connector's 7/16 male plug for 0.141" and 0.250" semi-rigid cable has a one-piece center contact that is easy to assemble and conforms to DIN 47223. The male plug has a direct solder, one-piece center and soldered outer jacket to simplify assembly and features less than –155dBc intermodulation. To assemble, push the semi-rigid cable through the back of the connector and then solder the center conductor. Providing dielectric withstanding voltage of 4,000VRMS and 50Ω impedance, this connector is designed for dc to 6GHz operation at –65°C to +165°C.

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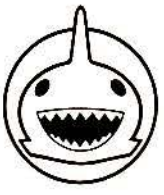

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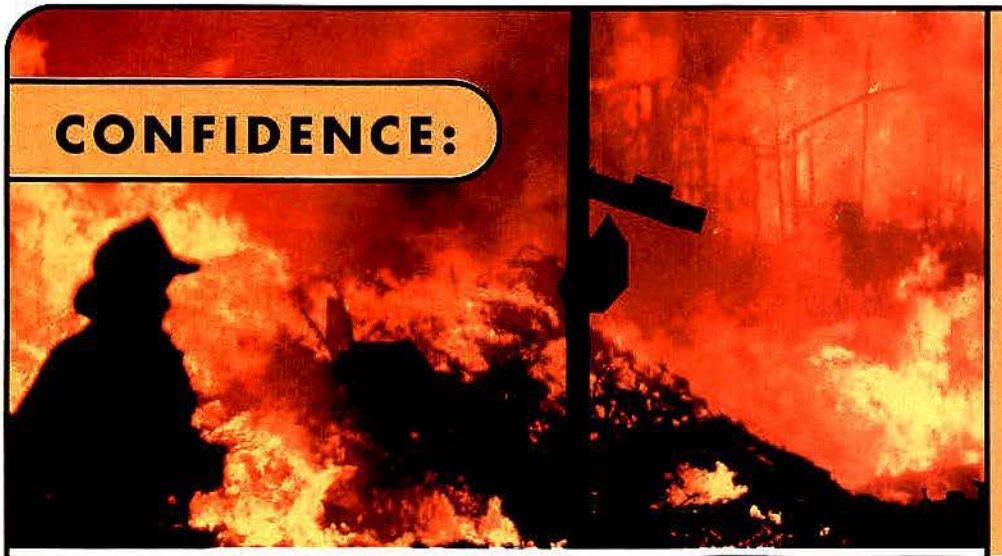

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The changing face of mobile radio

The old adage, "the more things change, the more they stay the same," certainly does not apply to the mobile radio market. The market is changing in a number of ways—some positive, some questionable and some downright negative. Let me give you some examples.

On the positive side, radio technology has come a long way. A land mobile radio representative I talked with recently told me that radios rarely break on their own. The technology has gotten that good. Radios break because of what is done to them.

On the questionable side is the nature of the marketplace. I had a great visit with a dealer not long ago. I know the mobile radio market has changed over the years, but I was curious about his perception of the changes. He noted that smaller players are leaving the market. Either they are quitting the business or the bigger players are acquiring them.

With the loss of the 'mom and pop' shops, the marketplace loses a bit of its soul.

Sad, but too true. With the loss of the "mom and pop" shops, the marketplace loses a bit of its soul. It loses the personal touch a smaller organization provides. The larger a company gets, the less personal service one receives. I received a telling email not long ago. The writer said that when he started his business he would travel a couple of hours to the company to pick up product. One time he walked in and the founder of the company was standing at the front counter. The founder knew his customers and greeted the writer. After the founder left the company, a corporate mindset crept in. As the writer noted, the company lost market share.

Can large companies provide customer service?

Sure they can. But, while many of the large players talk about customer service, my experience tells me it is harder for them to provide it to the degree they would like, or to the degree they think they are. How many companies have you seen that have "drill down" customer service? Half the fun in working with these companies is seeing how many menus you have to "drill down" before you can actually reach a human who is at all interested in your problem.

Then there are those companies who believe their product is the only choice in town. So if you have a problem, where else are you going to go? I call this "cable-company customer service." This is the customer service philosophy of: "We are here to serve you as long as you are available from 8 a.m. to 5 p.m."—all this so they can eventually tell you the problem is the end user, not the device.

There is also the customer "service thy self" approach, or how many troubleshooting logic tables must one go through over the phone with the "tech?"

I am combative when it comes to the lack of customer service. My wife calls me "The Terminator." If her attempts fail to get resolution to a problem, she unleashes me. It isn't pretty. But why should I have to be so aggressive to get a problem resolved?

The key to providing customer service is accessibility. Smaller companies are more prone to answering the phone, are more familiar with the specific product and more willing to do what is necessary to keep the customer happy.

Can the same be said of large companies? Yes and no. I contacted several police agencies to see how they are supported. The answers ranged from "adequate" (radios were no longer under warranty) to "great" (radios were under warranty).

I would be interested in hearing from you. What do you think? What are your experiences in getting customer satisfaction? I want to hear about the positive experiences as well as the less than positive.

Yes, Dorothy, there is a negative side

If there is a negative side to the mobile radio market it's the meandering management of the FCC. It never ceases to amaze me how they can muck things up. (I've already written about Nextel and Nextwave so I won't rehash them.)

We are the FCC's customers. Yet, if accessibility is key to good customer service, guess who doesn't have it. I recently made six calls to a bureau chief's office and didn't get one call back. I figure that a.) I'm too little a fish to bother with; b.) I should get a lawyer to make my calls; or c.) The commissioner read my columns on how they are handling Nextel and Nextwave.

So, how do I really feel about the FCC? I think the cartoon that accompanies Robert Schwaninger's column this month nails it.

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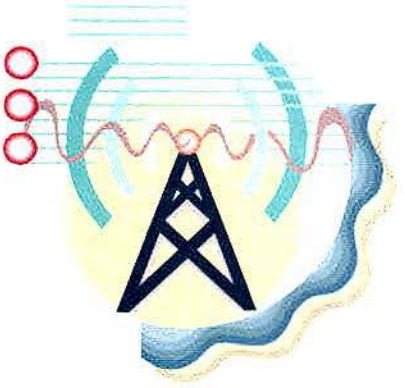

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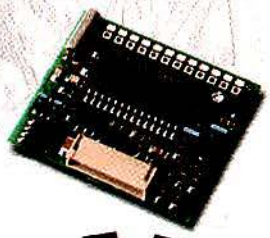
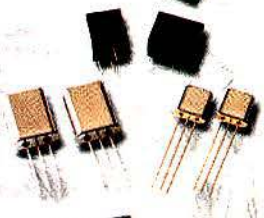
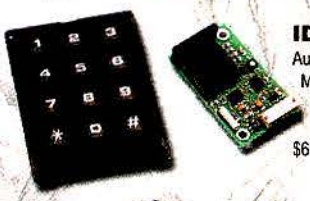


DCS-23
Digital Coded Squelch Encoder-Decoder
Jumper Programmable to all 106 DCS codes.
1.36" x 1.18" x 0.25"
$59.95

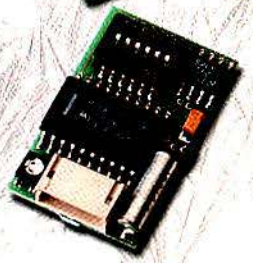


FILTERS
Call us for the lowest cost, 12.5kHz channel spacing, exact replacement crystal and ceramic IF filters for part 90 Reframing. Complete kits available for most popular radios at $15.00 to $25.00/kit.



ID-8
Automatic Morse Station Identifier
Meets all FCC ID requirements.
Fully field programmable with included keypad.
1.85" x 1.12" x .35"
$69.95

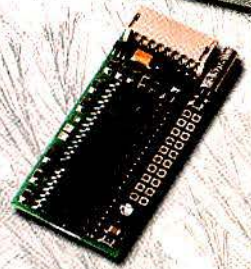
PE-1000
Desktop Paging Encoder
Two-Tone Sequential.
Other formats and custom tones available.
7.5" x 7.8" x 2.7"
$224.95



SS-64
CTCSS Encoder
Microminiature, DIP switch programmable.
Includes 64 tones from 33.0 to 254.1 Hz.
0.66" x 1.08" x 0.21"
$28.95

TE-32
Multi-tone CTCSS Encoder
Rotary dial switchable to any of the standard 32 EIA tones.
5.25" x 3.3" x 1.7"
$49.94
TE-32D with LED display, $99.95

TP-3200
Shared Repeater Tone Panel
Full featured and with all 157 CTCSS/DCS codes.
Desktop and rack mounted versions.
$279.95



TS-64
CTCSS Encoder-Decoder
Microminiature jumper programmable.
Includes 64 tones from 33.0 to 254.1 Hz.
0.78" x 1.70" x 0.25"
$54.95 (model TS-64DS with DIP switch, $57.95)

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Voice Encryption Units
PRIVATE COLLECTION™ series provides low to high level security for two-way radio voice applications.
PC programmable with optional kit.
0.9" x 1.5" x 0.25"
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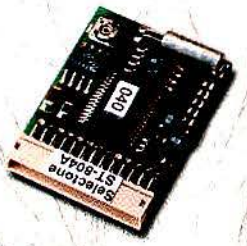

ST-804A
Multi Format Encoder
Encodes Two-Tone Sequential, Burst Tone, or DTMF ANI/ENI Formats.
PC programmable with optional kit, or factory programmed for free.
1.15" x 0.84 x 0.15"
$59.95

ST-809B
Multi Output DTMF Decoder
Decodes address codes of 1 to 7 digits from all 16 DTMF characters.
Multiple outputs and remote reset capability.
PC programmable with optional kit, or factory programmable for free.
1.34" x 0.85" x 0.21"
$59.95

ST-888
Desktop ANI Decoder / Display Unit
Use with ST-804A or other DTMF ANI encoders for monitoring of fleet radio users and control systems.
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